NUTRITION
AND SPECIFIC THERAPY

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NUTRITION AND SPECIFIC THERAPY

BY

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To The Memory of My Husband

MICHAEL A. LANE

SCIENTIST, SOCIOLOGIST, SCHOLAR
AND LEADER

I DEDICATE THIS BOOK

"Strong like the sun, and like the sunlight kind,
Heart that no fear, but every grief might move
Wherewith men's hearts were bound of powers that bind."

Swinburne.

PREFACE

The many demands during the past seven years for a book, based on my dietetic lectures to students, have prompted me to gather my material, and publish it in this little volume.

The book is the result of my own convictions and experiments, based, except where the author is quoted, on scientific facts and the researches of many of the best authorities of the world.

To the reader, the chapters discussing the cooking of foods, the value of milk as an article of diet both for children and adults (infants excepted), and the chapter on a meat diet, may appear somewhat reactionary. But to these readers I wish to say that it is due to my somewhat radical convictions that my experience with diet patients has been successful.

I have endeavored to present the subject matter in a very concise and practical form, and to give some information which possibly cannot be found as yet in other books of this nature. With this in mind, the chapters have been written on Auto-intoxication, Bacteriology of the Digestive Tract, Reforming the Intestinal Flora, and Vitamines, subjects which are of vital importance taken in conjunction with the study of nutrition. The hope is entertained that these chapters, together with the chapters on Diet in the Common Diseases, and Infants' Diets; Children's Diets, based on many of the most recent researches, if not convincing—either through omission or error on my part—may prove to stimulate interest and many questions. The remaining chapters have been planned to lend interpretation to these subjects.

I wish to express my deepest appreciation of the great inspiration that my husband's companionship afforded me in my work, and of the reports on clinical cases, from his pathological laboratory, based on the results of my diets,—without these much of the material in this book would have been impossible.

Dorothy E. Lane

March 19, 1922

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CHAPTER I

EXPLANATION OF THE SUBJECT OF NUTRITION

We hear and read that God intended the human race to eat certain foods, while others He did not create for human consumption. But it is a known fact that the great majority of people eat what they like and want, what environment and habit have accustomed them to demand, regardless of what is best for their bodies, and they exert a vast amount of labor in making many God-made natural foods as unnatural and artificial as possible.

The study of evolution proves the human race is what it is to-day because of its reactions to environment, and the foods it has eaten. Had man cultivated and eaten, of his own free will, other foods than those he has chosen, he would be a very different organism than he is to-day.

The study of immunology teaches that some people are immune to certain diseases, while others are not. This fact is also a result of the reactions of man to environment and of the chosen foods. What is food for one man is many times poison for another in the same locality, and in different environments under different conditions of living there is much diversity in the foods favored, or those relied upon through necessity. Strawberries, for example, are

a food for one person, but a poison for another in the same town. Again, a person can digest some foods on a cold day that cause nausea on a hot day. It is well known many people are immune to certain diseases in summer, but are very susceptible to them in winter.

It must be concluded that man to-day is what he is because of his habits through countless ages, and therefore, he will be to-morrow and in the far future a result of what his habits are to-day. So it is of the greatest importance that he choose the foods that are best for his own particular body in the environment in which he lives.

This is what the subject of nutrition teaches. It explains the composition of foods, how much heat and energy they produce, and how much new tissue they build; it tells about the digestibility and assimilation of foods; it takes up the subject of age, sex, occupation, and climate in relation to the different foods; and lastly it considers the food question in relation to diseases.

In order to do justice to this subject of nutrition and therefore to the human body, it is absolutely necessary to have a certain amount of knowledge of inorganic, organic, and physiological chemistry, of bacteriology and pathology. The lack of knowledge in these subjects accounts for much of the confused literature published on the food question and its relation to the body. With the above subjects in mind, the meaning of food composition should first be considered.

Food Composition.—All foods are composed of the so-called five food principles,—protein, fat, carbohydrate, mineral matter and water, or any combination of these.

Protein is a combination of the elements carbon, hydrogen, oxygen, nitrogen, generally sulphur, and sometimes phosphorus and iron; or it is, in other words, a complex of amino-acids linked together, with generally sulphur united in probably several different ways, and sometimes phosphorus and iron.

There are many different kinds of simple proteins, and the variety of ways in which the different amino-acids are combined, determines the different kinds of proteins in foods.

AMINO-ACIDS IN COMMON PROTEINS (HAMMARSTEN AND HEDIN).[1]

	Osborne and Clapp	*Osborne and Clapp*	*Osborne and Guest*	*Osborne, Jones, Clapp*
	Legumin	Hordein	Gliadin	Zein
Glycocoll	0.38	0.0	0.68 [9]	0.0
Alanine	2.08	0.43	2.0	9.79
Valine	1.0 [5]	0.13	3.38	1.88
Leucine	8.0	5.67	6.62	19.55
Isoleucine	——	——	——	——
Serine	0.51	——	0.13	1.02
Aspartic Acid	5.3	——	0.58	1.71
Glutamic Acid	13.8	43.19 [7]	43.66	26.17
Cystine	——	——	0.45	——
Phenylalanine	3.75	5.03	2.35	6.55
Tyrosine	1.55	1.67	1.20	3.55–10 [11]
Proline	3.22	13.73	13.22	9.04
Oxyproline	——	——	——	——
Tryptophane	——	——	1.00	——
Histidine	2.42	1.28	0.61	0.82
Arginine	10.12	2.16	3.16	1.55
Lysine	4.29	0.00	0.00	0.00

[5] Abderhalden and Babkin.
[7] Osborne and Jones.
[9] Abderhalden and Samuely.
[11] Kutscher.

Take for example the legumin of peas, and the gliadin of wheat,—the former is lacking in isoleucine, cystine, oxyproline and tryptophane, while the latter is lacking only in isoleucine and oxyproline. (This fact is important and will be referred to later on.) There is the protein of barley called hordein, the protein of corn called zein, the

[1] "A Text-book of Physiological Chemistry."

protein of milk called casein, the protein of egg called egg albumin, the protein of muscle called myosin, etc. The list of the many kinds of protein in foods is a long one.

Proteins differ in another respect also which gives a very interesting and important classification,—and in this they are divided into animal protein and vegetable protein. There is more nitrogen in vegetable protein and more carbon in animal protein. The nitrogen of vegetable protein is not as well absorbed as the nitrogen of animal protein for two reasons—first, it is more or less surrounded by starch and cellulose and for this reason it is difficult for the digestive juices to penetrate to it, and secondly, some of the nitrogen seems to be tied up chemically in such a way that it cannot be so completely absorbed. These facts are some of the arguments put forth against vegetarianism. (The significance of these facts will be discussed in Chapter III.) Atwater and Bryant give the absorption of animal and vegetable proteins as follows:—

Kind	Protein Utilized
Animal foods	97 per cent.
Cereals	85 " "
Dried legumes	78 " "
Vegetables	83 " "
Fruits	85 " "

These two kinds of protein, animal and vegetable, however, perform the same mission. They are called "tissue-builders." This is their purpose, but they are relied upon also to some extent, under certain conditions, to produce heat and energy for the body. Protein enters into the composition of all the body fluids and is a part of every cell nucleus. No life can exist without it. Therefore, since it is of such great importance, the absorbing question arises,—how much protein does man need in his food each day? The answer is one that has called forth endless

quantities of discussion and investigations, and will be considered in this chapter under the subject of the calorific value of protein.

The following foods give this daily supply of protein:—meats, eggs, milk, cheese, cereals, legumes and nuts. Other foods contain a very much smaller proportion of protein—such as fruits, vegetables, roots and tubers, but because of their small amount of protein, they are not classified as protein foods.

Fat is a combination of the elements carbon, hydrogen and oxygen. In other words, it is a compound of fatty acids with an alcohol. There are many different kinds of fats, depending upon the different fatty acids and alcohols of which they are composed. But the common fats of plants and animals are principally combinations of the fatty acids, oleic, palmitic and stearic with the triatomic alcohol glycerol (commonly called glycerin). The fats of fishes and of marine mammals contain other fatty acids than these and other alcohols than glycerol. When these fatty acids are combined with glycerol, they are called glycerides,—and when these three glycerides, triolein, tripalmitin and tristearin, are combined in a fat, the melting-point of the mixture depends upon the amount of each glyceride present,—the greater the amount of tristearin present the higher the melting-point, and the greater the amount of triolein present, the lower the melting-point.

The melting-point of common fats is as follows: (Taylor)

Horse Fat	60°–65° C.	(Has most tristearin)
Mutton Fat	50°–55° C.	
Beef Fat	45°–50° C.	
Lard	35°–40° C.	
Human	35°–40° C.	
Butter	30°–35° C.	
Olive Oil	—5° C.	(Has most triolein)

The melting-points of the fats have a great bearing upon their digestibility, for the lower the melting-point, the easier the digestibility.

This is true of uncooked fats, but not true of fats when raised to the frying and smoking temperature. When fats are raised to this high degree of heat, they are decomposed, and substances are produced which are irritating to the stomach. Therefore, when fats are cooked and raised to the temperature of frying, the fats with the highest melting-point are the most desirable because less of these irritating substances are formed. The frying temperature averages 350°–400° F. or 176°–205° C., which is far below the smoking temperature of the first fats in the following column.

Average Smoking Temperature of Edible Fats

Cotton-seed	233° C.
Snowdrift	232° C.
Crisco	231° C.
Leaf Lard	221° C.
Butter	203° C.
A Much Used Lard	190° C.

All persons familiar with cooking know there is much smoke produced when frying in butter or in a much used lard, and the reason is clearly shown in the above table, for the temperature necessary for frying is above the smoking temperature of butter and lard. In other words, when frying, Snowdrift, cotton-seed oil and Crisco are more desirable. The irritating substances formed are certain free fatty acids and the aldehyde, acrolein. These are irritating to the stomach, but in the normal digestion of fats in the intestines, the free fatty acids are not irritating and, for the most part, are formed into soaps by uniting with sodium, potassium, calcium and magnesium.

Fats are absorbed in the intestines to a large extent as soaps, and their ultimate end is to produce heat and energy for the body, and to form a certain amount of protective

tissue. To supply this the following foods are important: —olive oil, butter, eggs, cheese, nuts and soy beans. (Cheese is included in the list, but not recommended.)

The third food principle to consider is carbohydrate. It is a combination of carbon, hydrogen and oxygen, the same elements composing it as are found in fat, but the chemical arrangement of these elements is different. Carbohydrates may be divided into four main classes,—monosaccharides; disaccharides, trisaccharides, and tetrasaccharides; polysaccharides; and celluloses. The monosaccharides are the building blocks and are the simple compounds or sugars from which all the others are formed. The term disaccharides indicates there are two molecules of simple sugars, trisaccharides indicates there are three molecules of simple sugars, and tetrasaccharides indicates there are four molecules of simple sugars. In the polysaccharides there is an indeterminate large number of molecules of primary sugars, while the celluloses are of still larger molecular dimensions.

The following classification explains carbohydrates in detail:—

1. MONOSACCHARIDES,.......
   Hexoses ($C_6H_{12}O_6$)
   - Glucose (Dextrose or Grape Sugar)
   - Fructose (Levulose or Fruit Sugar)
   - Galactose
   - Mannose, Sorbose — Less Common

   The monosaccharides,—bioses, trioses, tetroses, pentoses and heptoses are less commonly found than the hexoses.

2. (a) DISACCHARIDES,..... ($C_{12}H_{22}O_{11}$)
   1. Saccharose (Cane Sugar),—hydrolyzes to 1 molecule of glucose and 1 molecule of levulose through the action of heat and water in the presence of an acid, and the enzyme, invertase, the latter taking place in the intestines.

2. Lactose (Milk Sugar),—hydrolyzes to 1 molecule of galactose and 1 molecule of glucose in the intestines through the enzyme lactase.
3. Maltose (Malt Sugar),—hydrolyzes to 2 molecules of glucose through the enzyme maltase in the intestines. It is formed through the action upon starch of diastase in malt, the ptyalin in saliva, and the amylase in the intestines, and in the partial hydrolysis of starch and dextrin by acids.
4. Trehalose,—hydrolyzes to 2 molecules of glucose. (Uncommon.)
5. Melibiose,—hydrolyzes to 1 molecule of glucose and 1 molecule of galactose. (Uncommon.)

(b) TRISACCHARIDES, ($C_{18}H_{32}O_{16}$) .... hydrolyze to 1 molecule each of levulose, galactose and glucose. Raffinose is a sugar belonging to this class, and is found in molasses, in sugar made from beets, in barley and in other grains.

(c) TETRASACCHARIDES, ($C_{24}H_{42}O_{21}$) .. hydrolyze to 2 molecules of galactose, 1 of glucose and 1 of levulose. Lupeose in peas belongs to this class.

3. POLYSACCHARIDES, ($C_6H_{10}O_5$)x ....

1. Starches..
2. Dextrins (Products of starch hydrolysis)
3. Glycogen (Chiefly of animal origin, but also found in certain fungi.)

hydrolyze to molecules of dextrose through the action of acids and through the action of the ptyalin of the saliva and the amylase and maltase in the intestines.

4. Gums.. Certain gums hydrolyze to molecules of a pentose or hexose.

	5. Mucilages
	6. Inulin, . . . hydrolyzes to molecules of levulose. It occurs in the dandelion, chicory and other vegetables.
4. CELLULOSES, ... $(C_6H_{10}O_5)^x$	hydrolyze to molecules of dextrose through the action of heat and water and sulphuric acid, and through the action of the digestive enzymes of certain animals.

The purpose of carbohydrates in foods is the same for the most part as that of fats,—to produce heat and energy. In digestion in the intestines they are all reduced to the simple sugars,—glucose, fructose and galactose with the exception of the celluloses which man does not digest, although these are digested by many animals.

The following foods are the main sources of supply of carbohydrates,—sugars, cereals, legumes, roots, tubers and fruits.

The combustions for the support of work first attack the carbohydrates of the body, and if these be present or supplied up to the need, work will be supported by combustion of carbohydrate alone. The body burns sugar in preference to fat if choice be presented. The sugar reaches the tissues of combustion in thirty to fifty minutes after ingestion.[2]

In the absence of sugar, the body will burn fat (of the diet or fat from the body depots) for the support of work, though the efficiency is a little lower than in the case of sugar. For extreme exertions, however, fat is the better food, since it is possible to ingest in a day more Calories in the state of fat than in the form of sugar. The diet should, however, always contain enough carbohydrate to avoid acidosis, and to save the catabolism of excessive protein.

In the presence of carbohydrate, the catabolism of protein is not modified or exaggerated by muscular work. Very exces-

[2] Taylor, "Digestion and Metabolism."

sive work, and especially work with untrained muscles, may lead to increase in total nitrogenous catabolism, but this is an abnormal reaction. Normally, work does not affect the protein catabolism. In a word, physical work under normal conditions does not noticeably affect the up-keep and wear-and-tear of the cells. In the absence of carbohydrate and fat, heavy work can be supported on the combustion of exogenous protein alone, but it is an exaggerated process, and under such circumstances, the endogenous protein catabolism is also exaggerated.

The fourth food principle is mineral matter. It includes principally the organic and inorganic salts of sodium, potassium, calcium and magnesium. There are other salts which are present in exceedingly small amounts. Iron, iodin, and *organic* phosphorus and sulphur are sometimes classified as mineral matter, but should be properly termed "elements" for they exist as organic compounds.

The principal inorganic acids are hydrochloric, sulphuric, carbonic and phosphoric, and there are many organic acids, principally tartaric, citric, malic, oxalic and benzoic.

Mineral matter is absolutely essential to all living tissues and fluids, and for neutralizing poisonous and waste products. (See Chapters II, VI, VII, VIII.)

Fruits and vegetables should be relied upon for the main supply of mineral matter. It is also found in a considerable quantity in milk, cereals, legumes, eggs, nuts, roots and tubers, but these foods should be eaten *principally* for other purposes, previously stated.

In other words, all fruits and vegetables have a certain amount of organic and inorganic salts,—elements such as sodium, potassium, calcium and magnesium, united with an organic or inorganic acid. (See page 11.)

The fifth food principle is water. This serves the function of carrying in solution gases and substances used in

ORGANIC ACIDS IN COMMON FRUITS AND VEGETABLES

Apple	Malic
Banana	"
Cantaloupe	Citric
Cherry	Malic
Cranberry	Malic—Citric—Benzoic
Currant	Citric—Malic
Gooseberry	" "
Peach	Malic
Watermelon	"
Spinach	Oxalic
Lettuce	Citric

the metabolism of all body cells. It also regulates the osmotic conditions of the body and likewise the temperature of the body.

Calorific Value of Foods.—The second subject to be considered in the study of nutrition is the calorific value of foods. By a calorie in physics is meant the amount of heat required to raise 1 gram of water 1° C. But this is the small calorie. For measuring the heat value of food, the large Calorie is used which is the amount of heat required to raise 1 liter of water 1° C. or 1 pound of water 4° F. Take 1 gram of the food in question,—how many pounds of water will it raise 4° F. when burned, or, as it is termed, oxidized? The result gives the calorific value of 1 gram of that particular food.

These results were obtained by burning protein, fat and carbohydrate in a machine called a calorimeter and these three food principles have the same heat value in the body as in the calorimeter.

The researches of Rubner were the first to give the following figures:—1 gram of protein has the calorific value of 4.1 Calories; 1 gram of fat has the calorific value of 9.3 Calories; 1 gram of carbohydrate has the calorific value of 4.1 Calories. Mineral matter, cellulose and water

have no calorific value, although they are of equal importance in other ways.

Therefore, protein, fat and carbohydrate are for different purposes, but in the end each is oxidized, and for every gram oxidized in the body, the stated heat values are obtained.

Because fat gives about 2¼ times the energy of carbohydrate and protein is no reason why it should be eaten in greater quantities. Fat is excellent in cold climates to produce heat and energy. It can replace carbohydrate to some extent, but it cannot replace protein, a certain amount of which is absolutely necessary to the cells and fluids of the body. Fat and carbohydrate can be stored in the body when eaten in excess of the required needs, but protein cannot be stored,—what is eaten in excess of the required needs is excreted. This is one of the great reasons why just the right proportion of protein should be eaten daily, —neither too much, nor too little, and if either of these errors is committed, sickness of some nature generally develops.

The best health is maintained on a mixed diet of protein, fat and carbohydrate with the required amount of mineral matter, cellulose and water and an adequate supply of vitamines.

The question may occur to the student,—why does fat give so much more heat and energy than carbohydrate? The answer is found in the number of carbon atoms in the fat molecule, for there are about three times as many as in the carbohydrate molecule. The exact molecular weight of protein molecules is still a mystery.

For those who wish to know how to obtain the calorific value of any particular food, the following rule is given, with illustrations.

The calorific value of any amount of food is obtained by reducing the amount of food in question to grams; know the percentage composition of this food; multiply

the amount of food in grams by the percentage composition of each of the three food principles; multiply these results by the calorific value of each of the three food principles; add the total Calories together.

Roast Beef (Lean) — 2 ounces = 56 + grams

	Per Cent.		
Water	55.3	56 × .292 =	16.3 grams protein
Protein	29.2	56 × .082 =	4.5 " fat
Fat	8.2	16.3 × 4.1 Calories =	66.83 Calories
Carbohydrate ..	0.0	4.5 × 9.3 " =	41.85 "
Mineral Matter.	1.4		
			108.68 "

108.68 Calories in a slice of lean roast beef.

Butter — ½ ounce = 14 + grams

	Per Cent.		
Water	9.1	14 × .013 =	.18 grams protein
Protein	1.3	14 × .829 =	11.60 " fat
Fat	82.9	.18 × 4.1 Calories =	.73 Calories
Carbohydrate ..	0.0	11.60 × 9.3 " =	107.88 "
Mineral Matter.	6.7		
			108.61 "

108.61 Calories in ½ ounce butter.

Bread — ½ ounce = 14 + grams

	Per Cent.		
Water	40.0	14 × .065 =	.91 grams protein
Protein	6.5	14 × .01 =	.14 " fat
Fat	1.0	14 × .512 =	7.16 " carbohydrate
Carbohydrate ..	51.2	.91 × 4.1 Calories =	3.73 Calories
Mineral Matter.	1.0	7.16 × 4.1 " =	29.35 "
Cellulose	.3	.14 × 9.3 " =	1.30 "
			34.38 "

34.38 Calories in ½ ounce of bread.

The question now arises,—how many Calories a day does a man, woman or child require to maintain perfect health? This brings up the subject of standard dietaries so much discussed with many differences of opinion. Age,

sex, climate and occupation are important factors in determining the required number of Calories for a particular individual. A child requires far less than an adult because of size, but again he requires more because he is growing; women require a little less than men; less food is required in a warm climate than in a cold climate; a hard working laborer requires more than a brain-worker.

The old standard dietaries for an adult doing an average amount of work advocated about 100 grams of protein, 50–100 grams of fat and 500 grams of carbohydrate. But the most recent standards give figures much lower, perhaps half this number, although there still is much diversity of opinion. Professor Chittenden of Yale has proved by laboratory experiments that it is possible to maintain life and do a certain amount of work upon 50–57 grams of protein a day. Professor Henry C. Sherman of Columbia University gives the figure of 45 grams of protein for a man weighing about 150 pounds. These figures are both low compared with those of Voit, Hutchison, Benedict, Meltzer and Cohnheim, whereas the figures of Folin's experiments range between the highest and lowest standards for protein requirement. Rubner has even declared that nitrogen equilibrium can be maintained on 35 grams of protein a day for a person of average weight, while Klemperer has obtained nitrogen equilibrium on 33 grams. Landengren, then Siven, Cedercreutz and Ernberg confirmed this low figure by an entirely different method. The figures of Hindhede are also extremely low.

The latest and probably the best calculated figures range around 2,400 Calories a day from the three food principles,—protein, fat and carbohydrate. This figure demonstrates that scientific research acknowledges people have been eating far too much for health, and that man requires far less food than has been imagined. Herein lies part of the great secret to banishing many diseases which will be discussed in other chapters. Diabetes may be cited here

as an example, for it is much more prevalent among obese people than those of average weight.

A very satisfactory rule in the author's work to determine the number of Calories required a day for any person in health doing moderate work is the following:—

Multiply the body weight by 1.3 to obtain the number of Calories of protein required a day. From this figure it is a very simple process to determine the number of grams of protein this figure represents,—simply divide the number of Calories of protein by 4.1 and the result is the number of grams of protein.

A person weighing 150 pounds would require 150 $\times$ 1.3 Calories of protein = 195 Calories of protein. Divide this figure by 4.1 and the result is about 48 grams of protein a day. However, if the person is a brain-worker, this figure should be even less. In other words, one-half pound of English walnuts would give the total protein requirement a day for this person. But many people do not consider one-eighth of a pound of nuts at the end of the third meal of the day as a food of any importance,—it is merely a finishing touch. When the protein intake from bread, butter, eggs, cereals, salad, meat, milk, potato, legumes, vegetables and fruits, that the majority of people eat in their three meals daily, is calculated, the number of guilty parties who have violated one of the laws of health would be enormous.

It is the author's opinion that if the number of Calories of protein for each particular person is accurately calculated, the carbohydrate and fat Calories take care of themselves to a large extent. The protein Calories should be kept about the minimum,—in other words, "nitrogen equilibrium" should be maintained which means that the intake of protein should equal the amount excreted,—any quantity above or below this is harmful. When it is said the fat and carbohydrate Calories will take care of themselves, this does not mean a person can indulge in quanti-

ties of commercial, concentrated, animal and vegetable fats, and sugars in the form of candies, pastries and sauces. One of the purposes of this book is to demonstrate that such foods are unnatural and many times harmful in many ways. Man requires many more Calories of carbohydrate than of protein or fat, but if the Calories of protein are carefully figured, a man may eat as much fat and carbohydrate food in a *natural* form as he desires to satisfy his appetite, and need not calculate their Calories, and will not go far astray. (Cane sugar and cream cheese are examples of commercial, artificial foods.)

In closing the discussion on Calories, it is fitting to call attention to a special kind of advertisements one reads everywhere in connection with the calorific value of foods. It is stated a certain number of Calories in a certain food costs a very few cents, and that the same number of Calories in other foods costs many times more. However excellent such a food may be, it cannot claim all the advantages of a mixed diet.

The entire aim in eating is not a question of obtaining the greatest number of Calories; the aim is to obtain the required amount of "complete protein" to maintain nitrogen equilibrium, a sufficient amount of carbohydrate and fat for heat and energy, a balanced mineral ration for the body's fluids and cells, and for neutralizing waste products, an adequate supply of the three or more vitamines necessary for growth and health, and a generous amount of cellulose to create active peristalsis. In other words man cannot live on a single article of food and maintain health, for there is no article of food that will supply the needs enumerated, except the mother's milk for the nursing infant.

Digestion and Assimilation of Foods.—This subject will close the chapter outlining the explanation of the subject of nutrition except for diets in special diseases which will be discussed in different chapters.

By digestion is meant the ease with which the food is disposed of in the stomach.

This is dependent upon:—

1. Kinds of Foods;
2. Preparation of Foods;
3. Combination of Foods.

The order in which different kinds of foods leave the stomach are,—carbohydrate, carbohydrate plus protein, protein, fat, and lastly fat plus protein which accounts for the delay of fried foods in the stomach.

Some protein foods require more pepsin than others,—for example, the gluten of bread requires five times as much pepsin as the casein of milk, but this fact does not necessarily mean that it takes five times as long for bread to leave the stomach, for some foods cause the gastric juice to flow faster than others.

It is therefore evident that when there is a great variety of food in the stomach, there is "indigestion" of some kind; for the food is delayed in its digestion and this always indicates bacterial fermentation or putrefaction. (See Chapters IV, V, VI.)

The conclusion is this:—The less variety at one meal, the quicker the digestion, and the better for the health; but the greater the variety, the three meals a day considered, the better for the health. Serve as few foods as possible at each meal, but serve generously of these foods, and vary each of the three meals a day, and the meals of each day of the week if possible. By following this rule, the seeker for health will obtain a "complete protein," sufficient fat and carbohydrate, a balanced mineral supply, an adequate amount of vitamines, and a generous proportion of cellulose. Variety is of the greatest importance in the question of health, and one of the primary reasons is because it provides a "complete protein" diet. Mendel, Osborne, McCollum, Hawk and others have devoted much of their time to researches along this line.

There are twenty-six known amino-acids derived from simple proteins required to keep the body in nitrogen equilibrium. Seventeen of these are the most common. Some foods contain only part of these, a very few contain all required for health, while still others may contain all, but not in the right proportion. The human body demands all these amino-acids, and in the required proportion. A varied protein food diet will insure this end. Foods known to contain "complete protein" are meat, milk, and eggs,—the soy bean [3] and peanut [4] (Rats were used in these experiments), coconut (See Chapter IX) and possibly the potato. Hindhede,[5] experimenting on men, also Thomas, Rose and Cooper (1917) have published extremely interesting information concerning the protein of the potato, and its power to maintain nitrogen equilibrium. McCollum [6] and his coworkers, however, in experiments on rats, conclude the nitrogen of the potato for growth has no greater value than an equivalent amount from corn and wheat. F. A. Cajori [7] has found many of our important nuts furnish ar adequate protein for rats.

According to recent investigations by Sherman [8] and his collaborators the protein of wheat, corn and oats will keep the body in nitrogen equilibrium if 9/10 of the protein is derived from these cereals, the remainder being furnished by *apple* or milk. These research men [9] also claim the proteins of oats and maize are of virtually equal nutritive value, and this is true whether the proteins constitute practically the sole nitrogen food or are supplemented by a constant small amount of milk protein. Human subjects were used in these experiments.

[3] T. B. Osborne and L. B. Mendel, *J. Biol. Chem.*, Dec., 1917.
[4] A. L. Daniels and R. Loughlin, *J. Biol. Chem.*, Feb., 1918.
[5] "Protein and Nutrition."
[6] E. V. McCollum, *J. Biol. Chem.*, Oct., 1918.
[7] *J. Biol. Chem.*, Dec., 1921.
[8] *J. Biol. Chem.*, Jan., 1920.
[9] *J. Biol. Chem.*, Aug., 1919.

Osborne and Mendel[10] conclude, in experiments on rats, there is evidence that the total proteins of rice and barley, in contrast with corn and oats, when furnished in diets containing 16 to 17 per cent of protein, supply enough of all the amino-acids for growth.

The conclusion to be drawn from these researches is that not all of the evidence is absolutely conclusive, and that experiments on different animals and on men do not always prove the same facts. This statement can also be applied to many other researches, especially on vitamines and mineral matter. But a certain amount of the results can be accepted as facts, and the questionable results point to many future researches in these subjects.

In conclusion, it may be said, the kind of food is of primary importance. The preparation of food should receive fully as much attention. This brings up the question of cooked and uncooked foods, the effects of cooking on the food principles, and the most desirable methods of cooking to obtain the best results for health.

[10] *J. Biol. Chem.*, June, 1918.

CHAPTER II

FOOD PREPARATION

Raw Foods and Effects of Cooking.—Heat coagulates protein, rendering both animal and vegetable protein less digestible at as low a heat as 170° F. or 77° C. When the protein is coagulated, a longer time is required for the pepsin, activated by the hydrochloric acid, to reduce it to peptones; and since this is true, the food may be delayed in the stomach, and bacterial fermentation and putrefaction may develop to a greater or less degree. Again, the acidity of the stomach contents becomes greater the longer the food is delayed in the stomach, and this fact adds to the length of time the food remains in the stomach, should the acid fermentation from the bacteria develop. It may, therefore, be said there are three objections to cooking protein, the resulting coagulation, and possible putrefaction and excess acidity.

Beef

Raw digests in 2 hrs.	Wholly-boiled digests in 3 hrs.
Half-boiled digests in 2½ hrs.	Roasted digests in 3–4 hrs.

Heat affects fat by causing a decomposition if it is raised to a sufficiently high temperature, with the liberation of free fatty acids and an aldehyde which are irritating to the stomach, and delay digestion.

Dry heat changes starch into dextrin at 300° F. or 149° C. and moist heat causes the cellulose which surrounds the starch granules to rupture and liberate the granules and these become swollen with water. The diges-

tive juices can then digest the granules much more readily, and therefore, the starch is more *completely* absorbed when cooked. But it cannot be said to be *more digestible,* for in the cooked state, it is more readily attacked by bacteria in the stomach, possibly causing fermentation which delays its digestion in the stomach. On reaching the intestines, this fermentation may continue. Sugars are unaffected by moist heat, except in the presence of acids.

Cellulose is affected in much the same way by moist heat as starch, for it may be made a more favorable medium for bacterial fermentation, with the production of oxalic, butyric and acetic acids and others that are harmful. These facts bear laboratory proof.

The great reason for cooking foods containing cellulose for the majority of people is to soften it. They think it is more digestible, perhaps better assimilated. Cellulose is not assimilated by man, for man has no enzyme either in the stomach or in the intestines to hydrolyze cellulose to dextrose. Man requires cellulose for bulk, and this is its greatest value,—that of promoting peristalsis. Cooked cellulose is far inferior to raw cellulose for promoting peristalsis. If the digestion is normal, an abundance of fresh salads should be eaten. Fresh fruits should be thoroughly washed before eaten, but not pared. Grape skins and the skins of potatoes should not be discarded.

Mineral matter in an inorganic form is not so readily affected by heat, but in the organic form, the changes are much more numerous,—it may be either thrown out of its organic combination, or it may be made from a soluble into an insoluble compound. An example of the latter is found in the boiling of lemon juice, when the citric acid of the lemon is changed from soluble tricalcium citrate into insoluble calcium citrate. Insoluble compounds sometimes are more difficult of absorption.

With these facts in mind, a very important question is presented. Is cooked or uncooked food the more desirable

for health? Naturally the answer is,—if heat coagulates protein, thus rendering it less digestible, and perhaps promoting bacterial action, it should be cooked as little as possible, or not at all. If protein foods are cooked, they should be cooked at as low a temperature and as short a time as possible. The greater the temperature at which they are cooked, the tougher and hornier they become. This fact is very clearly seen in the boiling of meat on the stove as compared with cooking it in a fireless cooker, and in the boiling of the white of an egg over the flame as compared with dropping the egg into boiling water and setting the pan on the back of the stove for 20 minutes.

However, there is one great problem with which to contend. It is true that meat eaters must cook their meat to kill the bacteria contained in it, and the meat should be cooked until all rawness has disappeared. Underdone meats contain many pathogenic bacteria such as those of splenic fever, tuberculosis, malignant edema, septicemia, chicken cholera,—tapeworm, trichina, etc.

It unquestionably follows that because heat at high temperatures decomposes fat with the liberation of irritating substances they also should be eaten in their natural state or cooked at a low temperature.

Since moist heat may prepare starches and celluloses for bacterial fermentation, and partly destroys the great value of cellulose for promoting peristalsis, these should never be cooked, except when absolutely necessary. Soluble starch and sugar is also lost many times in the different cooking processes.

The student has been taught that starch grains must be liberated to insure perfect assimilation. The membranes enveloping raw starch grains have been regarded as impervious to digestive juices. So it has been taught that it is very desirable to cook starch, and it has been said no starch appears in the feces after a meal of well cooked bread, potato or legumes. Despite these traditional teach-

ings, it has been found from recent investigations that raw starch is digested to a large extent. Langworthy and Deuel[1] have proved that raw starch granules are not swollen or broken, yet ingested quantities exceeding 200 grams a day disappear from the intestines. Raw corn and wheat starches were found to be completely assimilated,—78 per cent raw potato starch was assimilated.

Since cooking throws mineral matter out of its organic combination many times, and also changes it at other times from a soluble into an insoluble compound, and since also much is lost in draining vegetables, cereals, legumes, roots and tubers in many of the cooking processes, the conclusion must necessarily follow that foods relied upon for their mineral content should not be cooked.

Lastly, there are the enzymes and vitamines to consider in connection with cooking. Both are destroyed to a large extent,—some do escape, but why should the risk be taken of killing such vital substances? (See Chapter IX.)

With the above reasons in mind, it must be admitted raw foods have a great advantage over cooked foods for health. For instance, instead of cooking oatmeal two to three hours as cook-books advise, cook it ten to twenty minutes. (A recipe is given in the last chapter.)

Since cooking is almost universally the practice, the different methods of cooking many of the common foods are given in the following discussion:—

Food Adulteration by the Consumer.—Much has been heard about food adulteration by the producer and the many ways in which he has striven to delude the public into believing that it is obtaining money value in the products purchased. Every one enjoys the satisfaction of knowing that he has received value for value. The fact is, however, that the producer is by no means the only party that may not give fair returns to the consumer, for the consumer may not give fair returns to himself.

[1] *J. Biol. Chem.*, May, 1920.

If every home-maker in turn were asked how she prepares her vegetables, potatoes, cereals and legumes for the table the answer, aside from frying and baking, with but few exceptions, would be that in the case of potatoes they are peeled, thrown into boiling, salted water and cooked until tender; they are then drained from their water, seasoned and prepared in the various ways; in the case of spinach, celery, cauliflower, asparagus, cabbage, corn, peas and beans, the answer would invariably be that they are boiled in salted water till tender, and then drained. These facts are one of the great crimes of the culinary art, and show that the consumer adulterates the food and is cheated in nutritive value, flavor and cost. In this process of cooking, these foods lose in all their nutritive principles and absorb water in exchange. The food principles that are diminished mostly are the mineral matter, and carbohydrate, while some vitamines are destroyed, or lost.

Every home-maker would be horrified at the idea of throwing away the water in which fruits had been stewed. The fact is, however, that the water in which vegetables are cooked, which is generally thrown away, will average about the same in vitamines and mineral substances.

The body's great need for mineral matter and vitamines in carrying on its vital processes is apparent. The skeleton, muscles, nerves and blood all demand them, and the fruits and vegetables, principally, together with cereals, legumes, nuts, roots and tubers, and milk for infants, should be the chief source of supply. In these substances fruits and vegetables supplement the cereals, legumes, nuts, roots and tubers. (See Chapter IX.)

The American people are suffering from lime starvation, a fact plainly seen in the general decay of the teeth. (See Dental Caries and Pyorrhea, Chapter IX.) Milk has the largest proportion of calcium of any of our foods, and this is one of the reasons why it is recommended to so great an extent. Human milk contains the required amount for

infants, but cow's milk should not be relied upon for calcium for adults, as there are other foods with an adequate supply that are far superior for adults, which will be discussed in full elsewhere.

M. S. Rose[2] says:—"It seems possible to meet the requirement of the adult human organism for calcium, largely if not wholly, from carrots." This statement illustrates the importance of roots, tubers, fruits and vegetables as the principal sources of mineral matter. Cereals, legumes and nuts may be included, although they represent three of our protein foods.

It happens that calcium constitutes a larger proportion of the body than any other of the inorganic elements. To repeat:—It is required for bones, teeth, muscles, nerves, for the coagulation of the blood, for the digestive juices, and probably for many other functions. When the food consists principally of meat and cereals, the calcium requirement is not sufficient. But if the diet is rich in milk (recommended for adults only through necessity), yolk of eggs, legumes, fruits, vegetables, roots, and tubers, calcium equilibrium will be maintained. (See also Pellagra, Chapter IX.)

Sodium is a very important element of the blood and fluids of the body. It aids in the formation of the hydrochloric acid and other digestive juices. It is necessary for the formation of cartilage, it is found in the brain and it is necessary for the neutralization of waste products.

Iron is a constituent of hemoglobin, necessary for the supply of oxygen. It forms a part of the nucleins and nucleoproteins. It is necessary for the action of certain enzymes.

Iron derived from the hemoglobin of meat is not well absorbed, a fact which makes it all the more imperative that the preservation of fruit and vegetable iron should be guarded.

[2] *J. Biol. Chem.*, March, 1921.

Magnesium is important in the construction of bone and cartilage; it lends flexibility to the bones and contractility to the muscles. It also forms phosphates which are excreted in the urine.

Potassium is necessary as a tissue base and is to the muscles and softer tissues what the calcium is to the bones. It likewise aids in neutralizing poisonous products of metabolism.

There is practically no evidence that the body ever absorbs any greater quantity of mineral matter than is required in repair and elimination. If there is an accumulation in any particular tissue, the fault should be ascribed, in the majority of cases, to wrong diet first (many times a high protein diet), and the remedy should not be to reduce the amount of mineral matter, but to correct the faulty diet.

Since this mineral matter is so often lacking in the blood, and since the neutrality of the blood must be maintained, the body tissues themselves in these cases are required to give up their NH_2 groups, or inorganic elements, calcium for example, to neutralize the acids in the blood. Were this not the case, people would suffer much more frequently from acidosis than is now the case. However, if the body cells are called upon to continue this work, death is the result.

For those who wish to eat cooked food, the important question is,—what are the ideal methods for cooking vegetables, cereals, legumes, roots and tubers, foods that should be relied upon so extensively for their mineral content as well as for their carbohydrate, protein and vitamines?

For the sake of health, frying will be omitted and five methods will be considered in the order of their priority.

1. (a) Boiling in so small a quantity of water that none is left for draining,—peeled potatoes cut up small, carrots, turnips, parsnips, peas, beans,

lentils, spinach, cabbage, corn, celery, asparagus, onions, cereals. (Require close watching.)

(b) Stewing in double boiler,—cereals and all succulent vegetables.

(c) Baking,—any vegetable, root, tuber or legume and some cereals.

2. Steaming with skins on,—roots and tubers.
3. Boiling with skins on (draining necessary),—roots and tubers.
4. Steaming (large vegetables),—corn on cob, cauliflower, roots and tubers.
5. Boiling in large quantity of water and draining,—vegetables, roots, tubers, cereals and legumes.

If this last method is employed, the water in which these foods were cooked should be saved and used for soups or sauces.

In each of these processes the nutritive value and flavor in the end is different, and the one whereby none or the least water is drained off is the one that has retained the most nutritive value and flavor.

The losses in nutritive value from boiling and draining are about as follows:—spinach loses 50 per cent mineral matter, cabbage 35 per cent, carrots 12 per cent. In steaming about 10 per cent is lost.

This means a gain in the water content of these foods.

	Per Cent. Water in Raw State	Per Cent. Water in Cooked State
Parsnips	82.0	92.2
Cabbage	89.0	97.5
Spinach	90.0	98.0
Cauliflower	90.1	96.4

McCollum and Simmonds [3] make the following statement:—

[3] *A. J. Physiol.*, June, 1918.

Young animals cannot grow when fed a single seed or a mixture of seeds, even though the latter is supplemented with purified protein and a fat containing fat-soluble A vitamine. The inorganic content is the first limiting factor, and sodium, calcium and chlorine must be added before growth becomes possible.

Certainly these reasons in favor of preparing vegetables, cereals, legumes, roots and tubers with the greatest economy, especially in mineral matter and vitamines, with the idea of the promotion and preservation of health, should appeal to every one as facts that cannot be neglected.

CHAPTER III

MEAT OR MIXED DIET VERSUS VEGETARIAN OR LACTO-VEGETARIAN DIET

It has been said that the greatest value of meat lies in the fact that the quality of the albumin most nearly approaches that of our own tissues. But this statement has very little significance because both animal and vegetable proteins are hydrolyzed to the same amino-acids before they can be absorbed.

The statement has been made that a minimum protein diet for adults is necessary for health. The question may now be asked,—in what form should this protein be eaten, —should it be eaten as animal or vegetable protein? This subject has been discussed by some of the most able minds of the day.

The great naturalists, physiologists, and anatomists, Cuvier, Owen, Linnæus, Ray, Hunter, Carpenter, Bell and others have declared that the structure of the teeth and stomach show men to be properly adapted to a diet not of flesh, but of fruits, nuts and grains.

Most of the strongest, largest, longest lived animals are vegetarian,—the elephant, rhinoceros, buffalo, hippopotamus, bison, bull, stag, camel and horse represent this class. "All the carnivorous beasts are prowlers and most of them are stupid."

The observation has sometimes been made that "great nations are flesh-eating, but these nations have risen to greatness on a simple diet, and have acquired riches, have eaten expensively, and after a few score or a few hundred

years, have fallen into decay." Length of life and activity in old age are certainly more common among frugal vegetarians than among eaters of a mixed diet.

It has been proved that men living on a vegetarian diet lack initiative and great energy,—yet they have untiring capacity for labor and are less nervous. A difference is also seen in animals. The panther paces wildly, but the elephant, camel and horse are comparatively reposeful and have wonderful endurance.

William Lawrence, Professor of Anatomy and Surgery to the Royal College of Physicians, has said:

> The teeth of man have not the slightest resemblance to those of the carnivorous animals, except that the enamel is confined to the external surface. The teeth and jaws of men are in all respects much more similar to those of monkeys than of any other animals. The skull of the orang-utang has the first set of teeth, the number is the same as in man and the form so closely similar that they might be mistaken for human teeth.
>
> Man possesses a large cecum and a cellular colon which I believe are not found in any carnivorous animal.
>
> The carnivora have claws, a rasping tongue, pointed molar teeth, small salivary glands, a simple stomach, a smooth colon and an intestinal canal three times the length of the body. Man has nails, a smooth tongue, blunt molar teeth, well developed salivary glands, a stomach with a duodenum, a convoluted colon and an intestinal canal twelve times the length of the body. The saliva in the carnivora is acid, in man it is alkaline.

Bouchard and Charles Darwin have said that in ancient times man probably subsisted upon fruits.

Darwin proved that man does not belong to the carnivorous order such as the lion and the leopard, but to the herbivorous and frugivorous order such as the gorilla and the chimpanzee. Man's masticatory movements compare with those of the higher apes, while the jaws of the car-

nivora work like giant shears. Herbivorous animals secrete much more saliva in proportion to their size, and they have a long alimentary canal while the carnivorous have a short one. In the carnivora the hydrochloric acid is much stronger in order to prevent putrefaction, and their liver is much more powerful. The herbivora have a sacculated colon, while the carnivora have a smooth colon. The human alimentary canal is about ten times the length of the body,—that of the lion is only about four times the length of the body.

This latter fact seems to prove that man requires a vegetarian diet which provides bulk in the form of cellulose for the intestines. Meat protein is hydrolyzed to peptones in the stomach, and has only one more stage to reach before it is ready for absorption,—a long intestine would seem to be entirely unnecessary for this final chemical change. But on a vegetarian diet, the protein, fat, carbohydrates, and mineral matter are surrounded by cellulose and the digestive juices cannot readily reach them. Therefore, a long intestine seems necessary to furnish plenty of time and space for the digestive juices to accomplish their work, and for the quantity of bulk necessary on a vegetarian diet. Much larger quantities of food must be eaten on a vegetarian diet than on a meat diet, as the food principles are not so concentrated.

Frugivorous and herbivorous animals can be made to live on flesh. This has been tried in the case of the pigeon, horse, monkey and other animals.

Honorable R. Russell gives the following interesting facts concerning the diets of the different nations [1]:—

It is estimated that three-fourths of mankind in all known periods have been practically vegetarian. There have been, however, a good many races which have subsisted largely on flesh and some almost wholly,—the Eskimos and the Greenlanders for example.

[1] "First Conditions of Human Prosperity"; "Strength and Diet."

Professor Lawrence mentions the Lapps, Samoides, Ostiacs, Turgooses and Burats as living on flesh and as being among the weakest and least brave people of the globe.

Sir John Sinclair, of the early part of the last century, describes the Tartars as living wholly on flesh. Their strength was great, but their character extremely low and ferocious.

In the eighteenth century, the common food in Scotland was brose, porridge, oatmeal, flummery and greens, boiled with a little salt. Beer or milk was drunk. Scarcely any flesh was eaten. Both men and women were robust and subject to few diseases; none were of a nervous nature. In the lowlands of the north, to these foods were added some mixture of barley, rye or peas, potatoes, onions and butter. Brindley, the engineer, found that his workmen from Lancashire and Yorkshire whose fare was oat cakes, hasty pudding and water, did more work than the laborers of the south who ate bacon, bread, cheese and beer. In recent years the Scotch children have been fed on bread, tea and flesh and are not nearly as strong as formerly.

The Norwegians used to live on bread made of mixed rye, barley and potato, and later on, rye and barley bread, milk and cheese and occasionally slices of fish. They were healthy, strong and long-lived. The young people were able with ease to run by a carriage going full speed for twelve miles. Cheese, smoked reindeer, bacon and fish are now much eaten.

The staple food of the Swedish peasantry is rye bread. Milk and dairy products are abundant. The Swedes have been a fine strong race.

In Germany as in England and most countries of the world, well-to-do people have for a long time eaten flesh in large quantities, but the mass of the population has subsisted chiefly on black bread, milk, peas, potatoes and other vegetables.

The Flemish laborer has for breakfast, bread and butter, chicory, coffee and milk; for dinner, he has potatoes, vegetables and bread; for supper he has the same. Very seldom a little bacon and other flesh is eaten.

The Finns thrive chiefly on grain and vegetables, but also on some flesh.

The Swiss peasantry have lived on bread, cheese, milk, potatoes, vegetables and fruits, with flesh rarely in the country and frequently in the towns.

The government reports on dietaries of the laboring people of Europe in 1872 show that in most countries the fare was almost entirely non-flesh, but that in several countries flesh was eaten occasionally, as once a week or on Saints' days.

The Russians have lived on about a pound of coarse black bread and garlic, working for 10–18 hours a day. The fare of the peasantry has generally been black bread, milk, cucumbers, cabbage and other vegetables. Even in the towns, flesh was rarely eaten half a century ago.

The French peasantry, till recently, fared chiefly on plant foods, and are said to have lived longer and in better health than those who now consume more animal food and stimulating drink. In many parts of France in 1875, the peasantry only ate flesh once or twice a year, and in Brittany not at all.

The Italian peasants were wont to fare almost entirely on cakes and porridge of chestnut flour and wheat bread and Indian corn. They were a splendid, hardy people. The Italians in general live largely on maize, rice, vegetables, macaroni, eggs and fruit.

The food of the Spaniards for many generations consisted chiefly of coarse brown bread and grapes.

The Egyptian peasantry has lived on coarse wheaten bread, Indian meal, lentils and vegetables, and they have been among the finest of people.

The peasantry of Palestine have lived for the most part

on bread dipped in oil, rice, olives, grape treacle, gourds and melons.

The Greek boatmen were wont to live on rye or wheat bread, grapes, raisins and figs.

In Poland the chief diet has been bread and potatoes, and the Poles have been noted for their endurance.

The Arabs have lived chiefly on dates and milk. Their agility, endurance and strength are extraordinary. The rich classes have beef, goose and vegetables.

Rice has been the commonest food of most of the hot countries of Asia. In the Northwest Provinces, unleavened bread made of wheat has been the staple food, and has produced a hardy population.

The Chinese and Japanese peasantry who have lived on rice and vegetables with fish occasionally are about the strongest and most enduring workmen in the world. They use also pulses, fruits, roots and herbs. The rich classes include flesh. They do not use milk. (See end of Chapter VIII.) Soy bean cheese is a common food.

The Jews have for thousands of years lived on a mixed diet,—bread, lentils, dairy products, beans, vegetables, honey, fruit and flesh. They have been a fairly strong race.

The people of New England were accustomed to live on baked beans, potatoes, cod or mackerel. They were remarkable for physical and intellectual strength.

In Mexico and Peru, maize and bananas have long been the staple food.

The Chilian laborers have subsisted on figs, bread and beans.

An interesting view of the diet recommended by Socrates is given in Plato's "Republic":—

They will live I suppose on barley and wheat, baking cakes of the meal, and kneading loaves, salt, olives, cheese, boiled onions and cabbage,—figs, peas, beans and myrtleberries and beech nuts roasted at the fire, and wine in moderation. And

thus passing their days in tranquillity, they will, in all probability, live to an advanced age.

In these diets of nations, the fact is strikingly conspicuous that the great majority of the people have been vegetarian, either in the strict sense or the less strict sense when dairy products have been included, and they have all been noted for strength and endurance.

For untold centuries Buddhists and Brahmins have lived on a vegetarian diet. The old Greeks built their peerless empire on a meatless diet, and the armies of the Cæsars achieved their military victories principally on wheat. Pythagoras, Plato and Plutarch were vegetarians, and in modern times, Jean Jacques Rousseau, the social philosopher, and Shelley, the poet.

A high protein diet, which is synonymous with a meat diet combined with perhaps a quantity of dairy products and eggs, is undoubtedly responsible in whole or in part for many common diseases of to-day,—chronic rheumatism, kidney diseases, biliousness, pernicious anemia, neurasthenia, intestinal catarrh, colitis, arteriosclerosis, diabetes and many others.

Researches at the Pasteur Institute in Paris have indicated that animal protein decomposes twice as fast as vegetable protein in the intestines, and Bunge found that the toxins are four times as abundant in the intestines of flesh eaters as in those of persons living on a low, protein, vegetarian diet. Other research men have confirmed this figure.

A further argument in favor of a vegetarian diet is the fact that it is not subject to tuberculosis, anthrax, foot-and-mouth disease, septicemia, chicken cholera, tapeworm, trichinæ and other parasites.

Flesh foods as purchased are always in a state of putrefaction which is not destroyed by ordinary cooking, and bacteria enter the stomach where they often thrive in spite

of the hydrochloric acid, and then enter the intestines. Here this cooked protein is a most favorable medium for the countless putrefactive bacteria already thriving there. Paratyphoid, Bacillus enteriditis,[2] and streptococcus infections have been produced many times through flesh foods, and the Bacillus botulinus has been responsible for many deaths.

In the previous chapter the importance of lime was discussed. Meats are almost wholly lacking in lime, for one pound contains only one-half grain, but a pound of peas contains eight grains. Man does not eat the blood and bones of the animal as do the flesh-eating beasts, and consequently does not get all the necessary elements of life. Man drains off the blood containing the valuable mineral matter, and throws away the bones. The result is a generous supply of protein, potassium and extractives, or waste products, such as urea, uric acid and creatinine.

The following tables by Bunge show to what extent certain mineral matter is lacking in meat:—

100 Grams Dried Substance Yields Milligrams Iron as Follows (Bunge):

Eggs	10.–21.	Strawberries	8.6
Milk	2.24	Blackberries	7.2
Human milk	2.3	Raspberries	4.
Spinach	33.	Lentils	10.
Asparagus	20.	Peas	6.2–6.6
Carrots	8.6	Almonds	10.
Cabbage	4.5	Potatoes	6.4
Outer leaves cabbage	17.	Wheat-flour	1.6
Apples	13.	Wheat	5.5
Red cherries	10.6	Rye	5.
Dates	2.	Pearl barley	1.4
Figs	3.9	Rice	1. –2.
Pears	2.	Beef	4.
Grapes	6.		

All infants are born with a large amount of iron, which accounts for the above low figure.

[2] M. J. Rosenau and H. Weiss, *J. A. M. A.*, Dec., 1921.

100 Grams Dried Substance Yields Milligrams Lime as Follows (Bunge):

Cow's milk	1423	Yolk of egg	380
Human milk	243	White of egg	130
Strawberries	483	Graham bread	77
Figs	400	White bread	46
Dates	108	Butter	411
Prunes	160	Potatoes	100
Pears	95	Beef	24

Iron of Common Fruits in Order of Per Cent.

Strawberries	Grapes	Apples and clives
Watermelon	Prunes	Figs
Gooseberries	Blueberries	Peaches
	Cherries	

Calcium of Common Fruits in Order of Per Cent.

Strawberries	Olives	Pears
Watermelon	Grapes	Peaches
Figs	Cherries	Blueberries
Prunes		Apples

Iron of Common Vegetables in Order of Per Cent.

Spinach	Cabbage	Cauliflower
Lettuce	Asparagus	Carrots
Radishes	Onions	Potatoes

Calcium of Common Vegetables in Order of Per Cent.

Spinach	Radishes	Carrots
Cabbage	Onions	Cauliflower
Lettuce	Asparagus	Potatoes

Lentils have the highest per cent of iron of the legumes, —peas and beans have about one-half the amount of lentils.

Beans have the most calcium, lentils contain a little less, and peas have the least.

Iron of Cereals in Order of Per Cent.

Barley	Wheat and Rye
Oats	Corn and Rice
Buckwheat	

Calcium of Cereals in Order of Per Cent.

Oats	Wheat	Corn
Buckwheat	Rye	Barley
	Rice	

Sodium, potassium and magnesium can be considered in this same way and the vegetables, fruits, cereals, legumes, roots and tubers will be found to be rich in all these elements.

Eggs and nuts also have a very large amount of all these mineral substances, but they should be relied upon for their protein and fat principally. The author recommends only a small amount of eggs.

In the foregoing discussion it has been said that meats are laden with bacteria when purchased; they are twice as putrefactive in the human intestines as vegetable protein; they are many times laden with infectious diseases; they are lacking in mineral matter; and because of their high protein content, a most favorable medium for bacteria in the colon, they produce numerous times many of our acute and chronic diseases. These diseases are further encouraged on a high protein or meat diet for the reason that animal protein is too completely absorbed, inducing constipation. Man needs bulk and this he acquires by eating a certain quantity of cellulose each day.

There must be some reason for the universal American malady, constipation,—and the answer is lack of cellulose and a high protein diet. The most stubborn case of constipation can, in all probability, be cured if the patient will live on a low protein diet with an adequate amount of cellulose derived from fruits and vegetables, combined with cereals, legumes, roots and tubers (with the skins) and a generous amount of water.

The author is forced to conclude that a meat diet is against the laws for health for adults, and that it is particularly wrong for young children as their immunizing

organs have not been developed which aid in destroying the toxic substances produced by bacteria from meat in the intestines. Many authorities think the thyroid gland is the most important of these organs. These facts will be brought out clearly in the following chapter.

The majority of people think a vegetarian diet very limited. On the contrary, it stands for a diet of the greatest variety, as a greater variety of foods is desired when meat is not included. In this diet, cereals, legumes, nuts, or possibly eggs to supply the required protein, should be included each day.

The author does not include milk to supply required protein, mineral substances and vitamines for adults, although most authorities favor it. In some cases it may be valuable for a limited time, for example, in certain irritations of the digestive tract in which the foods preferably recommended by the author are not tolerated because of certain idiosyncrasies. In other cases it is sometimes valuable when a rapid gain in weight is desired, but milk as the sole article of diet should not be continued for too long a period in these cases, for it has been known to produce rheumatism and other infections because of too great a proportion of protein and putrefaction.

Milk is dirty and bacteria laden by the time it reaches the consumer, even though certified; it comes many times from diseased animals; it gives too high a protein diet and too many bacterial toxins absorbed from the intestines if relied upon as the sole article of diet, so often recommended in digestive disturbances, or if taken with the average meal; it is constipating because it is almost completely absorbed; it is the food primarily adapted to the calf.

Cheese has all the same objections as milk, plus the objection that there are no cheese standards such as those required for milk.

McCollum says:—

> Lacto-vegetarianism should not be confused with strict vegetarianism. The former is, when the diet is properly planned, the most highly satisfactory plan which can be adopted in the nutrition of man. The latter is fraught with grave danger unless the diet is planned by one who has extensive and exact knowledge of the special properties of the various food-stuffs employed.

These statements are in perfect accord with the author's convictions, which favor the strict vegetarian diet only for those who possess this exact knowledge. When strict vegetarianism is applied scientifically to the demands of the body, the reaction of the colon is acid, which has a decidedly favorable influence upon health. (See Chapters IV, V, VI.)

When a high protein diet is accused of being the cause of many diseases, the author does not include the acute and chronic infectious diseases in the same sense as that of the acute and chronic organic diseases, or possibly some deficiency diseases. Infectious diseases are caused by lack of specific antibodies (neutralizing and destroying substances) in the blood and tissues, and deficiency diseases by lack of specific vitamines in the foods and perhaps also mineral substances, and by an "incomplete protein." The author is convinced that certain of these antibodies are lacking a great many times because of wrong diet, especially a high animal protein diet lacking in mineral matter, and vitamines, but there is no conclusive laboratory proof of this fact. (See end of Chapter IV.) However, there is considerable laboratory proof that a high animal protein diet, or a diet insufficient for nitrogen equilibrium causes many acute and chronic organic diseases,—and that the lack of vitamines is either the sole cause or a contributing cause, combined with a high or too low protein diet, lacking in mineral matter, of deficiency diseases.

In closing this chapter, it is only fair to enumerate the great objections that have been read relative to a vegetarian diet:—

1. Tendency toward poor utilization of the food principles.

2. Blandness of such a diet, and lack of desirable stimulating qualities.

3. Necessity of consuming a large volume of food to furnish the requisite nutriment.

The author's answer is,—man's great aim should not be to absorb all he eats,—to keep the intestines free from harmful bacteria is fully as important; a vegetarian diet is not bland if one is not already overloaded with food,—on the contrary it is very stimulating if the person is hungry; man requires a large volume of food,—in other words a quantity of cellulose, to promote peristalsis and prevent the universal malady of constipation.

The following statements have been repeated many times (Tibbles):

'Vegetarians contend that their diet tends to health and longevity. But, it must be stated that the vegetarian is quite as liable to contract disease through his food or to suffer food poisoning as the flesh-eater.

The vegetarian urges that meat causes diseases of the liver, gout, stone, gravel, chronic rheumatism, skin diseases, disturbances of the vascular system, arteriosclerosis, kidney disease, migraine and kindred ailments; that ptomaine-poisoning may follow the consumption of meat; that the animal consumed may be the subject of anthrax, pneumonia, tuberculosis, glanders, various worms and other diseases, communicable to man. But quite as many examples can be produced against a vegetarian diet.

An excess of bread or other starchy food from the vegetable kingdom produces and promotes obesity, and sugar will produce evils similar to those following an excess of starch; it especially causes catarrh of the stomach, attended by an

abundant secretion of mucus. The ingestion of hard fruit, nuts and fibrous vegetables is a frequent cause of indigestion.

The communicability of disease is by no means confined to flesh foods. The advice of medical practitioners in the tropics is,—"Eat no uncooked vegetables, or any raw fruit, unless you can pare it or peel it." Enteric fever, dysentery, cholera, diarrhea and various other diseases have often been traced to a disregard of such advice. Even in northerly and temperate climates the consumption of raw, unripe or over-ripe fruit is a frequent cause of diarrhea. Actinomycosis is due to the ray fungus which enters the organism with green vegetables, such as watercress, celery, lettuce, etc. Ergotism is a disease which commonly affects the consumers of rye-bread. In fact, the superior freedom of the vegetarian diet from disease-giving properties vanishes entirely when the subject is carefully considered.

These remarks seem to fail to present a fair argument. It goes without saying that an excess of bread, etc., or an excess for that matter of any kind of food is harmful. All thinking vegetarians admit commercial cane sugar is detrimental to health. Indigestion is not caused from nuts, fruits and vegetables if properly masticated and eaten when ripe unless the person has a certain idiosyncrasy for these foods. The advice to avoid raw fruits and vegetables in the tropics is worthy of consideration because disease germs are much more abundant in these climates. However, this objection is nothing against a vegetarian diet because fruits can be peeled and vegetables should be cooked when necessity demands this, and in this form they are far superior to meats and other animal foods in these hot climates where putrefaction in the intestines would be still more abundant on a meat diet, both because of the meat itself, and because of the sedentary life of the people in these climates.

To complete this comparison of a meat diet with a vegetarian diet, the average food composition of each of the principal groups of foods is given:—

Meats (Average Composition)

Water	75.0	per cent.	(Varies with the kind of meat and the cut.)
Protein	16.0	" "	
Connective tissue	3.0	" "	
Fat	4.5	" "	
Mineral Matter	1.0	" "	
Extractives	.5	" "	

Milk (Average Composition)

Water	87.0	per cent.
Protein	3.0	" "
Fat	4.0	" "
Carbohydrate	5.0	" "
Mineral Matter	.7	" "

Cheese (Average Composition)

Water	36.0	per cent.
Protein	31.0	" "
Fat	28.0	" "
Mineral Matter	5.0	" "

Eggs (Average Composition)

Water	73.7	per cent.
Protein	14.8	" "
Fat	10.5	" "
Carbohydrate	0.0	" "
Mineral Matter	1.0	" "

The yolk is exceedingly rich in protein, fat and compounds of calcium, phosphorus and iron. The white is rich in protein, phosphorus and calcium. A small amount of carbohydrate is also present.

Dry Cereals (Average Composition)

Water	10.0–12.0	per cent.
Protein	10.0–12.0	" "
Fat	1.0– 5.0	" "
Carbohydrates	65.0–75.0	" "
Mineral Matter	2.0– 3.0	" "
Cellulose	2.0	" "

The bran and the germ of cereals are removed in the milling, and the result is a great loss in mineral matter,

protein and vitamines. These valuable substances are sold by the millers as feed for cattle, hogs and poultry. These animals, fed according to scientific rules, are not anemic and nervous.

There are many advertisements of "entire wheat flour" in all the magazines and labelled as such on the packages. But if the people will read a little further in these advertisements, they probably will see in very small print,—"(with part of the bran removed)." There is very little whole wheat flour on the market that is entirely "whole," and people who wish this, and all the substances so valuable for health will do well to send to some pure food store in one of the large cities or to some mill and have the flour sent direct to them.

One of the best cereal foods known to the author is the whole grain wheat itself, washed and then boiled in slightly salted water for about forty-five minutes, *and not drained.* A little experience will accomplish this in the given time. Probably the majority of people would prefer this cereal cooked longer as it will not be very tender at the end of this period, but the merits of short periods of cooking have already been discussed. Whole grain wheat can be purchased at pure food stores and cooked as desired, or it can be purchased already cooked and canned. This is served with butter or cream, with or without sugar.

Dry Legumes (Average Composition)

Water	12 per cent.	(The Soy Bean and
Protein	21 " "	Peanut excepted.)
Fat	1.5 " "	
Carbohydrate	55 " "	
Mineral Matter	2–5 " "	
Cellulose	2–6 " "	

It is interesting to compare the average composition of dried legumes and cereals,—their protein content being the important difference.

NUTS (AVERAGE COMPOSITION)

Water	4– 5	per cent.
Protein	15–25	" "
Fat	50–70	" "
Carbohydrate	10	" "
Mineral Matter	2	" "
Cellulose	1– 5	" "

Roots and tubers are primarily a carbohydrate food, although their mineral content is of great value. The following diagram compares their average food composition with that of vegetables and fruits.

VEGETABLES (AVERAGE COMPOSITION)

	p. c.	
	Water 92.0	
	Protein 1.0	
FRUITS—Same	Fat 5	Same—ROOTS AND TUBERS
Water .....85. p. c.	Carbohydrate ... 5.0	Water......85. p. c.
Carbohydrate.5.–20. "	Mineral Matter.. 1.0	Carbohydrate.5.–20. "
Cellulose.....3. "	Cellulose 1.0	

In other words, vegetables, fruits, roots and tubers are very similar in their protein, fat, mineral matter and cellulose content. Fruits, roots and tubers have less water and more carbohydrate than vegetables, and compare favorably with each other in their average composition of these two food principles, although the carbohydrate of roots and tubers is for the most part in the form of starch, while that of fruits is in the form of sugars. Fruits are higher in cellulose than vegetables, roots and tubers.

CHAPTER IV

AUTO-INTOXICATION

Auto-intoxication is a very inclusive term, and generally misunderstood in its exact meaning. A great many people have heard and read of this so-called disease, but have never had sufficient interest to inquire into this very absorbing subject and study its causes, effects and bearing upon the general health of the body. It may be termed a disease in itself, or it may countless of times be the forerunner of a great many of our common acute and chronic organic diseases,—and in the author's opinion it may also account for many infectious diseases, and be a contributing cause of deficiency diseases. It works like a thief in the night, slowly and surely poisoning the tissues, of every kind, and robbing them of their special functions.

The term, auto-intoxication, is disliked by many of the medical profession, yet there must be some name to apply to the body when metabolic and bacterial products from the intestines accumulate in it which prevent the normal functioning of the body's organs.

The chapters on cooked and uncooked foods, and on a meat versus a vegetarian diet have led up to this exceedingly important subject.

In studying the literature on auto-intoxication, the definition given by Professor Combe of the University of Lausanne, Switzerland, is in accordance with the author's convictions, and for this reason, a number of statements in his book are incorporated in this chapter.[1]

[1] "Auto-intoxication."

This investigator says,—"Auto-intoxication is a toxemia caused by substances formed through the influence of the vital processes of the body," and further states that it does not included infections or toxemias from tainted foods. According to his definition it is of two kinds,—from the functions of the tissues of the body and from the functions of the digestive canal.

The first type is again divided into two classes,—those auto-intoxications produced by the tissues and those produced by the antitoxic glands. Those produced by the tissues are the result of the metabolic decomposition of the living cells of the body, and are the normal products of the nutritive changes in the tissues. For example,—when the nucleins are destroyed into uric acid, purine bodies, xanthine, etc., and retained, uric acid diathesis of arthritis is the result. Secondly, when the albumins and fats are destroyed in too great quantity, the result is an accumulation of acetone and an acid intoxication. This type of auto-intoxication accompanies insufficient food, certain grave anemias, many intestinal affections and grave diabetes,—that is, it is observed whenever the fats and albumins of the body are destroyed in exaggerated proportions. The liver plays a very important rôle in connection with preventing this form of auto-intoxication by transforming, oxidizing and conjugating the harmful catabolic products into harmless ones which are for the most part excreted by the kidneys. It is claimed it reduces to one-fourth the toxicity of the poisons eliminated by the kidneys.

The second type of auto-intoxication produced from the functions of the tissues is a toxemia produced by insufficiency of the antitoxic glands ("immunizing glands"). These are divided into glands of external secretion and glands of internal secretion. To the first group belong the kidneys, liver, intestinal mucosa, respiratory tract, sweat glands and salivary glands. Consequently, when

the kidneys do not function normally the result is uremia with an accumulation of toxic substances from the digestive canal and from the catabolism of the body tissues; when the liver is at fault the result is cholemia; when the intestinal mucosa does not prevent toxic bodies from entering the circulation, many grave results follow; when the respiratory tract, which eliminates carbonic acid, ammonia and perhaps acetone, and the sweat glands which eliminate small quantities of urea, ammonia, phenols, indol, and volatile fatty acids, and the salivary glands which at times may eliminate such substances as urea, do not perform these functions, the result is an auto-intoxication from these glands of external secretion.

To the second group belong the antitoxic glands of internal secretion. These furnish the body with substances indispensable to health or they destroy by their antitoxic power substances noxious to the body. Whenever one of these glands does not function normally, toxic substances accumulate in the body.

In this way tetany is produced from insufficiency of the parathyroid bodies, myxedema from insufficiency of the thyroid gland, acromegaly from insufficiency of the pituitary body, Addison's disease from insufficiency of the suprarenal capsules, diabetes from insufficiency of the pancreas, etc. These are the glands also that render substances harmless which have been absorbed from the alimentary canal, and which have been produced as a result of the breaking down of the body cells.

The second kind of auto-intoxication, according to Combe, is produced from the functions of the digestive canal, and is a toxemia caused by qualitative or quantitative alterations in normal digestion. In this is included the digestion by enzymes of the stomach, intestines and pancreas and also that by the bacteria which inhabit the digestive tract.

The digestive enzymes convert starches into sugar, fats

into fatty acids and glycerol, and proteins into amino-acids and ammonia. The bacteria do the same, but the action of the bacteria is not limited to producing these products. They carry the process farther and produce from these substances such products as hydrogen, carbonic acid, hydrogen sulphide, and methane; they produce irritating acids such as caproic, valeric, butyric, and propri-onic; they produce aromatic bodies such as indol, phenol and skatol, and ptomaines such as cadaverine and putrescine. The above substances are not always harmful, but are when produced in quantities above normal, while certain ptomaines are always harmful even in very small amounts (Armand Gautier).

To elucidate the chemical changes that take place through this bacterial action, the following examples of its effect upon hydrolyzed and native food principles are given:—

The putrefaction of tyrosine gives cresol and phenol (carbolic acid); the putrefaction of tryptophane gives skatol, indol and pyrrol; the fermentation of sugars and the putrefaction of fatty acids produce oxalic and butyric acids, carbonic acid, etc.; the putrefaction of certain amino-acids, cystine for example, gives hydrogen sulphide, etc., and this gas is probably always harmful. The mechanical action of carbon dioxide and hydrogen is generally beneficial if not produced in too great quantities.

Most of the phenol and indol enter the liver where oxidation and combination occur, and so they enter the circulation in a much less harmful form. In this way indican is produced,—this is present in all stagnations of the small intestines. It is not necessarily the result of constipation, although generally speaking, this condition is present. Sometimes indican indicates certain diseases, such as those of microbic suppuration. It is often found in anemia, tuberculosis and diabetes.

One-tenth of the protein in our food may be said to be

subject to bacterial decomposition. If a larger proportion than this is putrefied, the toxic substances produced by the bacteria increase beyond the control of the glands of external and internal secretion, and auto-intoxication is the result.

The conclusion regarding the bacteria in the intestines is that they are useful when they carry digestion as far as the digestive enzymes, but that they are harmful when they transform the digestive tract into a laboratory of poisons. Protein putrefaction occurs almost entirely in the large intestines where the reaction is alkaline, and fermentation of carbohydrates in the small intestines. This fermentation makes the reaction of the small intestines acid in spite of the alkalinity of the digestive juices there. Sometimes both putrefaction and fermentation take place in the stomach.

If one antitoxic or eliminating organ fails to perform its function, others may supplement it and auto-intoxication may be delayed for a time. This condition, however, cannot continue indefinitely and the liver, kidneys and other organs, overstimulated as they have been, finally are forced into a condition of hypoactivity. At this point the toxins from the catabolism of the body tissues and from the digestive tract begin to accumulate and the result is a hyperproduction and a hypodestruction of toxins and the various acute and chronic organic and perhaps certain infectious diseases ensue. These may be various heart diseases, nervous diseases, glandular diseases, skin diseases, etc., according to the particular person in question. Often there is an effort on the part of the body to throw off these toxic substances through vomiting, diarrhea, bilious attacks and salivation.

Every stomach that does not promptly digest its food is transformed into a laboratory of fermentation and putrefaction, and this condition is then produced in the small

and finally in the large intestines, and many abnormal states of the body may result,—constipation, diarrhea, diseases of the intestines, appendicitis, dilatations, dyspepsia, pyloric stenosis, flatulency, etc. To this list may be added headaches, fever, dizziness, tonsillitis, asthma, urticaria, diseases of the gums, diabetes, kidney diseases, arteriosclerosis, anemias, etc.

When once the condition of auto-intoxication is established, what is offered in the way of treatment? According to many authorities, the antiputrefactive diet is a lacto-farinaceous diet (meat excluded). It has been proved there are four times as many toxins produced on a meat diet as on a lacto-farinaceous diet. But this is the same as saying that the replacing of meat with milk does not prevent putrefaction, but that it only reduces it. The pure culture sour milk preparations made with the Bulgarian bacillus prove more beneficial than sweet milk in this diet, although the value of these milks has been overestimated.

With the exclusion of meats and milk from the diet, the farinaceous foods are the only ones remaining on the list, with the exception of eggs, which should be classed with meat and milk, but which, in the author's opinion, do not seem to produce the harmful substances if eaten in small amounts. An added advantage is that eggs are sterile and not laden with bacteria like meat and milk. Although classed as protein foods, cereals, legumes and nuts may also be designated as farinaceous foods since they all contain starch. To these should be added the farinaceous foods,—roots and tubers, and to a lesser degree the fruits and vegetables may be included as farinaceous or carbohydrate foods.

The author's treatment consists in following the sixteen antitoxic rules for reforming the intestinal flora outlined in Chapter VI, giving special thought to maintaining

nitrogen equilibrium on a protein diet little above the minimum, this depending upon the age, sex, climate, occupation and weight of the person. (See Chapter I.)

Professor Combe gives the following treatment:—Diminish nitrogenous putrefaction in the intestines so as to bring it back to normal if the antitoxic organs are competent. Bring nitrogen putrefaction to a point below normal if the antitoxic organs are insufficient. Stimulate the antitoxic functions when they have become insufficient.

All authorities admit that in convalescence and growth the protein ration must exceed considerably the minimum of nitrogen equilibrium.

Many authorities do not advocate raw foods because they claim they are laden with bacteria. But repeated investigations have proved that sterile, vegetarian food modified the proportion of bacteria very little in the intestines. (See Rule 15, Chapter VI.)

Author's summary: Auto-intoxication may be a disease in itself caused by a temporary fermentation or putrefaction; it may be the direct or secondary cause of acute and chronic, organic and deficiency diseases produced by wrong foods, which are the primary, indirect cause; it may be the indirect, secondary cause of some infectious diseases, the lack of antibodies being the tertiary cause, and the bacteria, themselves, the direct cause. In other words, it is caused by too much or too little wrongly prepared and combined foods, or wrong foods, deficient in mineral matter and vitamines, which stagnate, ferment and putrefy in the alimentary canal, and these toxic products are absorbed which cause the eliminative organs and antitoxic glands to become overstimulated and finally worked into a state of hypoactivity. Vitamines and mineral matter are lacking which are necessary for metabolism, the vitamines perhaps being necessary for the fixation or functioning of the mineral matter. Coincident with this condition the body's metabolism is wholly deranged and the products of catab-

olism are not eliminated, and accumulate, and finally are expelled through various channels. In the meantime the many acute and chronic organic, and possibly some infectious and deficiency diseases may have made their inroads.

The production of indol in the colon from tryptophane by bacterial putrefaction and its transformation into indican by the liver in which form it is rendered comparatively harmless and as such is excreted in the urine, has long been known.

The advocates of a low protein, vegetarian or lacto-vegetarian diet, are daily confronted with the following question:—Why is it that in the case of two persons living under the same conditions and eating the same food, say a high protein meat diet, one is perfectly well while the other has many symptoms of auto-intoxication, such as, neurasthenia, muscular exhaustion, constipation or diabetes? The answer may be found in the fact that there may be the same amount of indol and other poisons formed in the intestines of these two persons, but in the case of one, the lining of the intestines does not permit the poisons, for some reason, to pass through into the blood, while in the case of the other, the lining does not act as a defensive agent, and these poisons are allowed to pass through. In the first case, therefore, it would be expected that there would be a considerable quantity of these poisons in the feces and very little in the urine. In the other case, conditions should naturally be the opposite. Again in these two persons, the epithelial lining of the intestines may act to a very slight degree as a protection against putrefactive poisons and consequently large quantities may be carried to the liver from the intestines. Here, however, there may be a difference in the protective power of the liver in these two persons. In the healthy person these poisons may be conjugated, oxidized and otherwise transformed into harmless substances such as the conjugation of indol with potassium and sulphur which is indican; in

the sickly person the liver may not readily perform these functions. Innumerable such reasons might be cited as an explanation of the many times asked query. The answer to this mystery may be found in temporary impaired functioning of the sympathetic nervous system through causes other than diet. As a result, indican and other poisonous substances in the urine are not always a sign of auto-intoxication. But generally an analysis of the poisonous and waste products of the urine is significantly indicative.

To illustrate the effect of meat poisons absorbed from the intestines, the following experiment was demonstrated at the laboratory of Professor Pawlow:—A dog with Eck's fistula (the portal vein, which carries the toxin laden blood to the liver to be rendered harmless, was attached to the vena cava), recovered in a few days on a vegetarian diet; but when it was fed on a meat diet, the dog died within three days because the toxins from the meat were carried into the general circulation without being rendered harmless by the liver. A dog has a liver four times as large as a man's in proportion to his size. A dog for this reason can thrive on a meat diet far better than man.

All literature seems to point to the increase of diabetes, kidney diseases, appendicitis, neuritis, rheumatism, diseased tonsils, pyorrhea, etc. Surely there is some powerful cause which produces these pathological conditions, and it is the author's conviction that this cause can be controlled if educators will make it a part of required education to teach enough of the subjects outlined in the beginning of this book to enlighten people about the functions of their own bodies. How many people are as well versed in the physiology and requirements of their own bodies as they are in the different arts,—and the innumerable other studies and subjects that occupy all their thinking hours?

There is an old saying,—"Most men dig their graves with their teeth," and another one says,—"The science of

living begins at the mouth." Never were two statements more true.

A very common symptom of auto-intoxication is indicanuria in children. These children are irritable and difficult to control, and extremely fickle in their appetites. Their circulation is often at fault, and they are constantly taking cold. Their susceptibility to tonsil infections may be due to this cause. Their sleep is perturbed.

These children do not appear exactly ill, and a physician is therefore seldom consulted. So these cases drift along, restless, anemic, and unhappy. By the time adult life is reached, there are pronounced, abnormal symptoms of perhaps the heart, the kidneys, the appendix, the bladder, the pancreas, etc. These unwary sufferers begin to think and question and wonder how and why their bodies' functions have become disturbed,—and the majority never are enlightened, or understand, but try many useless cures from that time on till death finally claims these unfortunate victims of auto-intoxication.

Paul R. Cannon [2] says after eliminating cases of chronic infections in the digestive tract or elsewhere and those which have been shown to be the result of nervous reflexes, "there are still many instances of acute and chronic conditions in man in which no fecal infections have been found, and in which there is definite evidence of an intoxication of intestinal origin." He states there is a contrast in the tendency of animal and vegetable proteins to encourage putrefaction in the intestinal tract. "Torrey pointed out this peculiarity when he found that vegetable proteins do not offer the slightest encouragement to the growth of the intestinal putrefaction types of bacteria. My experiments agree with those of Torrey in that vegetable proteins not only reduced the relative proportion of proteolytic types, both aërobic and anaërobic, but also encouraged the overgrowth of a nongas-producing aciduric flora; animal pro-

[2] *J. Infect. Dis.*, Oct., 1921.

teins on the other hand, such as meat, fish and eggs, led to an enormous overgrowth of gas-forming proteolytic types."

Underhill and Simpson [3] have found that the diets which give rise to the excretion of phenol and indican in large quantities are the ones that lead to the overgrowth of putrefactive bacteria in the intestines. Meat led to a marked increase of phenols and indican, whereas casein caused much less phenol and indican. These research men found vegetable proteins to produce the same amount as casein, but the experiments of Cannon and Torrey, according to the above statement, do not confirm these results.

In connection with the author's convictions that autointoxication may be caused by deficiencies in the diet, which may be a contributing cause of infectious diseases, the following researches by S. S. Zilva [4] are of interest and point to a broad field of research in this subject. He states that besides the radical changes produced by deficient nutrition already recorded, it is quite possible that decided modifications may take place in the body tissues and fluids which are not discernible macroscopically or microscopically, but which may nevertheless restrict physiologically the functions of the organism. In this connection arises the interesting problem whether the resistance to disease of the animal is in any way influenced by deficient nutrition. (See Pernicious Anemia.)

Zilva carried out experiments with deficient diets on amboceptor and agglutinin formation and the complement content, but says that owing to the complexity of the subject, the experiments can be considered only of a preliminary character. The results obtained, although of an unexpected nature, are nevertheless of general interest, and suggest the necessity of future investigations. Rats and guinea pigs were used in these experiments.

The influence of the following dietetic deficiencies on

[3] *J. Biol. Chem.*, Oct., 1920.
[4] *Biochem. J.*, May, 1919.

the production of these antibodies (neutralizing and destroying substances) was studied.

1. Deficiency of calcium, iron, potassium, chlorine, phosphorus.
2. Deficiency of certain amino-acids.
3. Deficiency of the three vitamines.

Only the group which received a diet deficient in phosphorus showed a decidedly poorer response to the inoculations in the production of amboceptor and agglutinins. Growth was restricted in these experiments.

In conclusion, he states that a systematic study of the influence of nutrition on the production of immunity, although complex and laborious, is urgently called for, and may not only prove to be of direct clinical value, but may elucidate many obscure points in the complicated mechanism of immunity.

CHAPTER V

BACTERIOLOGY OF THE DIGESTIVE TRACT

In the preceding chapter, the author's conviction is stated that certain bacteria of the alimentary tract are the principal cause of auto-intoxication, which in turn may be the cause or a contributing cause of organic, infectious, or deficiency diseases. Bacteria in this region are always present, and harmful, with a few exceptions, when carrying digestion farther than the enzymes.

According to F. P. Underhill and G. E. Simpson "the pioneer work of Herter and Kendall, and more recently of Rettger and his coworkers, and of Torrey shows that diet is effective in regulating the character of the intestinal flora." The author is indebted to Professor Herter [1] for some points of interest concerning the characteristic intestinal flora of childhood and adult age.

Because the digestive tract is extremely abundant with bacterial forms, many research men in this subject have endeavored to solve the meaning of this fact. There are some animals of the arctic regions such as polar bears, seals, reindeer and ducks that have no bacteria in their digestive tracts.

Many experiments have been carried on to determine whether bacterial life in the intestines is essential to development,—some investigators have said yes, while others have said no. But the fact remains that in the tropical and temperate climates it is impossible to avoid the en-

[1] "Bacterial Infections of the Digestive Tract."

trance of bacteria into the digestive tract. Some forms seem to have a beneficial effect, such as those that produce lactic acid, while others are pronouncedly harmful. But the normal body is provided with more or less efficient methods of defense against the harmful bacteria; the acidity of the gastric juice destroys them; the pepsin of the stomach, the trypsin of the intestines, and other enzymes digest many of these bacteria; the intestinal mucosa prohibits the passage of many bacteria into the tissues; the liver destroys many others that do escape through the intestinal lining; the spleen destroys others through its production of antibodies,—and other defenses exist which are not so well understood.

These bacteria may be classified into three groups,—the aërobes, the anaërobes and the facultative anaërobes. The aërobes are those bacteria which require free oxygen for their development; the anaërobes thrive where there is no free oxygen; the facultative anaërobes multiply best in the presence of free oxygen, but can also increase under the same conditions as the anaërobes.

The aërobes are the bacteria found in the normal colon and are antagonistic to the anaërobes, because of certain acids which they produce,—especially lactic acid. Many facultative anaërobes are also present in the normal, healthy colon. The strict anaërobes are those that characterize the colon of auto-intoxication where the medium is alkaline, and not acid as in the healthy colon. They, in other words, are those that produce putrefaction.

Bacteria, like all living things, require nitrogen for their development. Therefore, protein and protein derivatives are utilized by bacteria for their growth and energy, and carbohydrates and fats are also a source of energy.

These bacteria can be absolutely regulated by the diet chosen in any particular locality. The character of the food, its solubility and its volume, together with the composition of the digestive juices, determine the bacteria of

the digestive tract. Roger has said there are about 160 varieties in the alimentary canal.

First Bouchard, then Roger, Metchnikoff, Tissier and others took up the subject of these bacteria.

While bacteria are always present in the digestive tract, yet they are not always the same at all times of life. Professor Distaso, assistant to Metchnikoff, at the Pasteur Institute, Paris, in an exhaustive research in relation to the intestinal bacteria, found the following to be true, which also confirmed work done by Professor Tissier, also of the Pasteur Institute:—Within a few hours after birth a protective germ, the Bacillus bifidus is found in the intestines. So long as the reign of this germ lasts, the infant remains in a healthy condition. But when the intestines become infected with the Bacillus coli and others through cow's milk during the nursing period, and later through the many other foods given a young child such as meat broths, meats, eggs, etc., these delicate bifidus germs are driven out, and the way prepared for the development of the putrefactive bacteria. These are the bacteria that are responsible for the majority of the ills of infancy, childhood and adult age. The bifidus germs that are not destroyed aid in stimulating the colon and preventing constipation.

In nurslings the bacteria of the intestines are very simple. A few examples are the Bacillus bifidus of Tissier, the Bacillus lactis aërogenes, and the Bacillus acidophilus. There are a few of the Bacillus coli and Bacillus aërogenes capsulatus, also called Bacillus welchii Bacillus perfringens, the gas bacillus, and other names.

Bottle-fed children have a great number of bacteria even when the milk has been pasteurized or sterilized. The number of bacteria in raw cow's milk ranges from 1000-2000 per c.c. in certified milk, to several million per c.c. in uncertified milk. Ordinary cow's milk contains 100,000 per c.c.

There is, therefore, a striking difference between the bacteria of the intestines of nurslings and the bacteria of the intestines of infants fed on cow's milk, for in the case of the latter there are many more of the Bacillus coli and many less of the Bacillus bifidus. There are numerous others such as diplococci, the Streptococcus lacticus, certain staphylococci, the Bacillus aërogenes capsulatus, the Bacillus proteus vulgaris which forms indol and skatol from casein, the Bacillus putrificus, etc. Streptococci are known to produce severe cases of ileocolitis in infants and children.

According to Paul Heinemann, there are two kinds of streptococci in market cow's milk. The one that produces intestinal disturbances and septic sore throat is the pathogenic, fecal and sewage streptococcus; the other is the Streptococcus lacticus which is the ordinary bacterium which coöperates with the Bacillus aërogenes lacticus in producing lactic acid in milk.

In other words, the lactic and succinic acid forming bacteria (beneficial bacteria) become less and less numerous and the putrefying bacteria become more and more numerous as age advances, according to the food ingested, or in other words, the aërobes decrease and the anaërobes and facultative anaërobes increase.

It is found there is a great difference between the number of anaërobes in the intestines of adults on a meat diet as compared with the number on a vegetarian diet. The anaërobes are diminished by two-thirds in the presence of large quantities of carbohydrate and cellulose. The conclusion is evident, namely, that a vegetarian diet produces acid forming bacteria in the intestines which prevent putrefaction.

In view of this fact, it is interesting to cite some important facts concerning the Bacillus coli, so universally present and commonly discussed.

In the first place its action can be controlled by the diet

chosen,—it can be rendered either beneficial or harmful, or it may be said that the diet can be so regulated as to force the Bacillus coli either to produce fermentation or putrefaction. Secondly, this bacillus cannot hydrolyze native protein (the proteins as found in unchanged foods), but the Bacillus aërogenes capsulatus and other anaërobes, especially Bacillus putrificus, can hydrolyze native proteins. On a meat diet, there are many of the Bacillus aërogenes capsulatus and similar bacteria present, and a great deal of unabsorbed cooked, partly digested protein reaches the large intestines. These anaërobes then hydrolyze the proteins that escaped absorption, and being very numerous, they also attack any fats and sugars that escaped absorption. There are quantities of prepared food for the Bacillus coli, in the case of a high protein diet, from which to produce toxic substances, and other facultative anaërobes together with the strict anaërobes add to these toxic products. Examples of such substances are butyric acid, hydrogen sulphide, phenol, skatol, indol, putrescine and cadaverine. Thus the Bacillus coli is forced to produce quantities of indol on a meat diet or a high protein diet.

There is, therefore, the greatest necessity for a low protein diet and for prompt absorption, when practically no unabsorbed protein reaches the colon. Under these conditions the anaërobes cannot thrive and the Bacillus coli and others of this class are compelled to produce fermentation because of the great quantity of carbohydrate present, especially if much of the food has been eaten in the raw state in the form of salads, fresh fruits, figs, dates, prunes and raisins, and nuts, or if it has been cooked for only a short period. The reason for this is that a considerable quantity of carbohydrates escapes absorption through increased peristalsis, and consequently reaches the colon where the Bacillus coli flourishes.

Much has been written about the Bacillus coli in relation to its producing deadly poisons which give rise to degeneration of the liver, kidneys, blood-vessels, nerves, etc., and as has been said, these poisons are produced mainly from animal protein; whereas in the presence of an abundance of carbohydrates and cellulose, the colon germ produces harmless acids instead of deadly poisons.

In an article published by Dr. Robert Morris, the following statements have been made:—The Bacillus coli probably stands next to the tubercle bacillus in the proportion of deaths which it causes. Dr. Morris charges this bacillus with being the cause of diseases of the appendix and inflammation in the region of the pylorus and duodenum and many cases of gastric disturbances. It is said sometimes to cause gall-stones, and that diabetes may be the result of an inflammation of the pancreas set up by the colon bacillus. It is also said that hardening of the liver and arteries may be caused by it more than by syphilis or alcohol, and that it may prepare the way for infantile paralysis, and may cause many cases of neurasthenia. In scarlet fever, diphtheria, measles, typhoid fever and other infectious diseases, this bacillus is often the only one found in the urine. Cases in which patients have suffered from albumin in the urine have been cured by the removal of an inflamed appendix from which the colon bacillus entered the circulation.

The author's conclusion is that in these infections the toxins produced on a high protein diet, lacking in mineral matter, may have interfered with the production of antibodies for combating these particular infectious diseases.

Professor Herter has made numerous experiments for the purpose of determining the effects of indol (formed from the amino-acid tryptophane) upon the body produced by the colon bacillus and other bacteria under anaërobic conditions, and has found that this poison produces head-

ache, insomnia, irritability, coated tongue, sallow complexion, dullness of mind, cold hands and feet and a score of other symptoms.

Professor Herter gives the following types of chronic excessive putrefaction:—

1. Indolic.
2. Saccharo-Butyric.
3. Combination of the two.

In the first the Bacillus coli may invade the small intestine and produce indol there as well as in the large intestine. In the second type the Bacillus aërogenes capsulatus is the most prominent. This bacillus thrives on carbohydrate as well as protein and produces much butyric acid and gas. This type of putrefaction is widespread among adults, and it is claimed there are few people who do not suffer from it from time to time. They experience great muscular and mental fatigue, mental depression and emotional irritability. Ammonium butyrate is formed in large quantities which is very irritating, often producing diarrhea and irritation of the entire digestive tract.

There seems to be little doubt that in time these types of putrefaction will lead to many of the common afflictions of man,—colitis, appendicitis, kidney diseases, acidosis, rheumatism, neuritis, etc., and that they will prepare the way for many other types of diseases.

CHAPTER VI

REFORMING THE INTESTINAL FLORA

Having considered the different types of bacteria that are ever present and thrive in the intestinal tract and the effects produced by them, the next question of interest is to determine how *best* to regulate their growth which has so great a determining influence upon health.

From the foregoing chapter, it is fully evident that the diet should be so regulated that the acid forming bacteria predominate. All scientific men interested in the subject of diet agree on the beneficial effects of lactic acid in the large intestines, a fact first popularized by Metchnikoff. Every reader has doubtless read or heard much on the subject of conveying to, or producing in the large intestines, lactic acid which, as has been said, antagonizes anaërobes and combats putrefaction. Much literature has been written concerning the consumption of large quantities of buttermilk, kumiss, kefir, etc.

It is the author's opinion that the value of these foods containing lactic acid or lactic acid forming bacteria has been greatly overestimated. When lactic acid is taken directly in the food, it is generally completely absorbed before it reaches the colon, and if the bacteria themselves are ingested, they are in all probability killed or digested before they reach the large intestines. Pure culture lactic acid milks very probably hasten digestion in the stomach because the clot formed by the rennin is smaller and not so tough; they also may favor peristalsis in the small intestines and consequently in the large intestines,—these two reasons may speak favorably for the lactic acid prepa-

rations, but they do not confirm the hopes that the acid itself or the bacteria ever reach the colon. For those who wish to prepare buttermilk for the above reasons, the Yogurt tablets may give a certain amount of satisfaction.

The best known of the beneficient germs or aërobes is the Bacillus bulgaricus discovered by Grigoroff. This germ produces lactic acid from glucose and consequently this bacillus has been put up in tablet form to be eaten as such three times a day or used for producing buttermilk, in the hopes of flooding the colon with lactic acid to combat putrefaction. But the fact that sugar is generally completely absorbed before it reaches the colon gives the Bacillus bulgaricus a very poor chance to develop in the colon, even if it escaped the effect of the hydrochloric acid, and later, digestion in the small intestines, especially on a meat diet in which the carbohydrate ration is low. By what scheme then can the Bacillus bulgaricus and similar bacteria be developed in the colon? The answer would seem to suggest itself in the light of what has been written in the previous chapters. On a vegetarian diet, and especially a raw diet, some of the starch and sugar necessarily would seem to escape absorption in the small intestines and would reach the colon. There the bacteria that hydrolyze starch to sugar, and oxidize the sugar to lactic acid are in the majority, and the perplexing problem would seem to be solved. In other words, the author's conclusion is that the most efficient method whereby to obtain lactic acid in the colon is not through eating these tablets or drinking lactic acid preparations, but by living on a low protein diet (so-called vegetarian diet), with a generous supply of salads and fruits, for under these conditions the aërobes that normally thrive in the colon will be forced to produce the much desired lactic acid.

To show the preservative effects of lactic acid, an interested experimenter immersed a piece of beefsteak in buttermilk made from a culture of the Bacillus bulgaricus,

and kept it in a state of preservation for several years. If this is true, the fact is clearly demonstrated that lactic acid antagonizes anaërobes and prevents putrefaction.

With these facts in mind, the following rules for encouraging the growth of aërobes will prove helpful:—

Sixteen Rules for Reforming the Intestinal Flora.— 1. To reform the intestinal flora completely, all animal protein must be excluded for the time being, which includes meats and fish of all kinds, and also milk, cheese and eggs. In extreme cases of putrefaction and auto-intoxication this is absolutely necessary (tests for CO_2 in the blood, and indican, uric acid and urea in the urine are indicative). In milder cases some eggs may be allowed.

The most efficient procedure for completely reforming the intestinal flora would be to withhold all food for 24 hours, giving nothing but water and possibly a cathartic of Pluto water. At the end of this period, give only fresh fruit juices for 24 hours. Then gradually increase the diet according to the rules enumerated.

2. The diet should consist of unrefined cereals, legumes (cooked no longer than is absolutely necessary), nuts and possibly some eggs (in other words, the four most ideal protein foods according to the author). Nuts should be eaten as the principal protein food of the meal and not at the end of the meal as a side dish. Combine these four protein foods with a generous supply of roots and tubers, fresh vegetables and fruits. The cereals should be unrefined except in cases of an irritated digestive tract, and should never be drained after cooking. The roots and tubers should be eaten with the skins if possible, because of their protein, mineral matter, vitamine and cellulose content.

Prunes, figs, dates and raisins are excellent fruits if purchased in a sanitary condition. Honey is an excellent food.

3. Drink several pints of water a day.

4. Take some kind of physical exercise.

5. Do not overeat. This is best accomplished by omitting animal foods.

Never eat merely because it is meal time. Appetite and hunger should not be confused. There is an old saying,—

"Three meals for animals, two for man and one for angels."

There are many people who live on two meals a day, especially during the summer months. The author recommends two meals a day the year round for many brain workers.

A person should not eat too often. Those so-called pangs of hunger without reason in the middle of the forenoon or afternoon do not denote hunger. They are probably due to customary reactions of the stomach formed through the habit of eating between meals. A person who has formed this habit should realize that "a single caramel or nougatine may furnish sufficient energy to supply the extra heat needed to walk a mile." [1] Another calculation says that "one-half doughnut or six walnuts give enough Calories (80) to walk from the bottom to the top of Washington Monument.[1] Perhaps it can be learned from this how futile a constitutional walk is in any attempt to combat the accumulating energy from undue eating between meals."

6. Do not eat too little. Nitrogen equilibrium must be maintained, sufficient carbohydrate and fat must be eaten to produce the required amount of heat and energy, there must be a balanced mineral ration for all the tissues and body secretions, a sufficient quantity of cellulose to promote normal peristalsis and an adequate supply of vitamines for health.

7. Habitual use of tea and coffee should be prohibited as far as possible. The tannin interferes with digestion and the caffeine paralyzes the sympathetic nerves of the

[1] C. G. Benedict, F. G. Benedict, *Boston M. and S. J.*, Oct., 1919.

intestines, and aids in causing arteriosclerosis. They often produce gastric catarrh, nausea, headache and other symptoms.

8. Tobacco and alcohol produce many pathological conditions,—gastric catarrh, dyspepsia, irritation of the mucous membranes, irregular heart action, defects of vision, arteriosclerosis, etc.

9. Condiments should be prohibited,—horseradish, mustard, pepper and spices. All are generally constipating and irritating to the digestive tract, liver, blood-vessels and kidneys.

10. Vegetable fats should be chosen in preference to animal fats, which are more difficult to digest and more easily putrefied. Nuts with their 50 per cent fat, olive oil, etc., and soy beans (18 per cent fat) are excellent.

11. Cane sugar should be eaten in very small quantities. *Large amounts* (100 grams) give rise to gastric catarrh, and produce oxalic acid which in large quantities gives rise to oxaluria. The symptoms of this condition are dyspepsia, nervous exhaustion, and mental distress. It also produces alcoholic fermentation, gas and the irritating butyric acid. Calcium in the body very readily combines with oxalic acid, forming calcium oxalate, which appears as "gravel" in the urine. As a result, the body is robbed of its necessary calcium. In this connection it is interesting to read that in 1598 Heutzer, a German traveller, thus describes Queen Elizabeth, then 65 years old,—"Her nose is a little hooked, her lips narrow and her teeth black, a defect the English seem subject to from their great use of sugar."

Commercial cane sugar is probably the most concentrated, artificial food product on the market, for the sugar cane juice is bleached, neutralized, coagulated, filtered, centrifuged, clarified and evaporated in vacuo,—and the American citizen is reported to average one-fourth pound

a day of this artificial product, which depresses gastric secretion.[2]

Cane sugar is wholesome in small amounts as found in all fruits and some vegetables, roots and tubers, cereals and legumes. But the sugars to which the stomach and intestines are adapted in larger quantities are milk sugar, malt sugar (produced by the action of the ptyalin of the saliva on starch, and also by the pancreatic enzyme, amylopsin in the small intestines) and dextrose and levulose. Beet sugar and maple sugar are chemically indistinguishable from the product of the sugar cane.

A word here may be added in favor of a small amount of unbleached molasses, which is the residue from the refining of the juice of the sugar cane. Sorghum, so extensively grown in this country, is made from the African millet, and is a wholesome food if unbleached with sulphur compounds.

12. Avoid iced drinks and very hot drinks. Iced drinks chill the stomach and retard digestion. The stomach has few sensory nerves and consequently does not react against the hot liquids so frequently poured into it that in reality have almost burned the mouth.

A very safe rule is to drink before or at the end of a meal, or drink in small quantities with a meal, water that is neither ice cold nor very hot. Drinking with meals as a rule causes one to drink too much, and this may result in dilatation of the stomach, or it may cause the food to be swallowed in lumps and consequently digestion is delayed in the stomach and bacterial fermentation and putrefaction result. Sipping small amounts of water with meals may prove beneficial by stimulating the flow of gastric juice. A. C. Ivy [3] says:—"The ingestion of water with the meals (400–800 c.c.) increases the amount, and the free and total acidity of the gastric juice. The inges-

[2] *A. J. Physiol.*, Aug., 1920.
[3] *A. J. Physiol.*, April, 1918.

tion of water with the meals decreases the emptying time of the stomach, due to the dilution of the stomach contents."

13. Avoid fresh breads and pastries of all kinds. They are prone to produce fermentation and putrefaction in the stomach and intestines.

14. Avoid complicated menus for reasons previously stated.

15. Wash all fresh fruits and vegetables very thoroughly before serving them raw. (The Bacillus putrificus is often on the surface.)

16. Avoid cathartics except in cases of emergency. They do not decrease the intestinal putrefaction when habitually used, except as they stimulate peristalsis and force a mechanical voiding of the anaërobes. The reduction in these bacteria is merely transient, and is followed by the usual putrefactive bacterial development.

With these rules in mind, a pint of water drunk at night and the use of a certain amount of sterilized bran each morning will probably combat the most stubborn case of constipation. (See Cathartics, Chapter X.)

These sixteen rules signalize unretarded digestion and prompt absorption. In other words, these are the rules for reforming the intestinal putrefactive régime, and for combating constipation, and the resulting numerous diseases. Peristalsis may be stimulated to such a degree that there are two movements a day, but this is a result to be desired rather than one to cause worry.

Referring to Rule 7, the chemical composition of tea, coffee and chocolate is given on pages 72 and 73.

The amount of caffeine in the two kinds of tea does not materially differ, but the percentage of tannic acid shows a much larger proportion in green tea. This fact is accounted for by the process of fermentation to which the black tea is subjected which renders a portion of the tannic acid insoluble.

TEA

	Green Per cent.	Black Per cent.
Water	5.96	8.2
Caffeine	2.33	3.2
Albumin	16.83	17.2
Alcoholic Extract	7.05	6.7
Dextrin	.5	——
Pectin	3.2	2.6
Tannic Acid	27.1	16.4
Chlorophyll	4.2	4.6
Cellulose	25.9	34.0
Mineral Matter	6.	6.2

Pectin present in tea and many vegetables, roots and fruits is a kind of carbohydrate, a substance which has not yet been prepared in a pure state. It gives to fruit juices their property of gelatinizing. If fruits are too ripe, the properties of the pectin are lost, and the juices cannot be formed into jelly.

Caffeine is a trimethyl purine and theobromine, the corresponding substance in chocolate and cocoa, is a dimethyl purine. They are almost identical with uric acid which is formed as a waste product of the body.

Chlorophyll is the green coloring matter of plants, particularly associated with vitamine A.

COFFEE

	Per cent.
Water	.6
Caffeine	.8
Saccharin Matter	.4
Tannic Acid	4.7
Alcoholic Extract	14.1
Fat and Oil	13.5
Legumin	11.2
Dextrin	1.2
Cellulose	48.6
Mineral Matter	4.5

The caffeine and tannic acid in coffee are present in a much smaller amount than that found in tea, but the amount of each in an infusion of tea and coffee is approximately the same because a much stronger infusion of coffee is generally demanded. A cup of coffee or tea contains about four grains of caffeine and five grains of tannic acid. About 35-40 per cent of the coffee used in making the infusion goes into solution.

Cocoa Bean

	Per cent.	
Water	5.2	
Fat	50.4	
Carbohydrate	4.2	
Albumin	6.3	
Tannic Acid	5.7	(4.7 in coffee) 27.1 and 16.4 in tea
Gum	2.1	
Cellulose	6.4	
Theobromine	.8	(same as coffee) 2.3 and 3.2 in tea
Cocoa Red	2.2	
Mineral Matter	2.7	

Cocoa preparations from the bean have much less fat, about 26 per cent and consequently more carbohydrate, about 25 per cent, and more protein, about 20 per cent. Sweet chocolate contains about 50 per cent fat and 40 per cent cane sugar. Many people cannot digest chocolate because of its high fat content.

Honey

	Per cent.
Water	20.
Dextrose	35.
Levulose	40.
Gums, Wax, Essential Oils, Coloring Matter, Mineral Matter	5.

Rhubarb and Spinach.—This is perhaps a fruit and a vegetable that should be generally forbidden. Their prin-

cipal acid is entirely different from the other vegetable and fruit acids such as citric, malic and tartaric. These acids are oxidized in the body and form carbonates. But the high per cent of oxalic acid in rhubarb and spinach is a poison,[4] and cannot be oxidized, and is excreted in the urine for the most part as calcium oxalate. Only a mere trace of this acid is found in the majority of fruits and vegetables, but there is a considerable amount in tea, coffee, cocoa, sorrel and pepper. McCollum [5] says there may be an injurious effect brought about by prolonged administration of oxalic acid. (See Cane Sugar, Chapter VI.)

The body produces and eliminates daily, from protein, fat and carbohydrate, and also from fermentation in the intestines, about .02 gram.[4] In eating one-fourth pound of rhubarb or spinach, one would ingest about four grains of oxalic acid or about thirteen times the amount which the body normally eliminates daily. (If drained, iron as well as oxalic acid is removed from spinach.)

An occasional meal of spinach or rhubarb has no ill effects, but spinach is habitually recommended by physicians for anemic patients and infants and children as a daily necessity. What is the reason for this with the above facts in mind, and why are not quantities of lettuce and many other foods,—cabbage, apples, strawberries, oatmeal, lentils, etc., with their extremely high iron content recommended with the same enthusiasm as spinach. Spinach may have a slightly higher percentage of iron, but patients quickly tire of spinach and will relish larger amounts of these other foods for a longer period of time. It is the author's opinion that lettuce and cabbage (green is the best,—see Chapter IX) should be greatly favored in place of spinach. They can be cooked, but are best served in salads. They should be advised twice a day

[4] "A Text-book of Physiological Chemistry," Hammarsten and Hedin.
[5] "The Newer Knowledge of Nutrition."

for anemic patients, serving them once in a vegetable salad and then again in a fruit salad.

Loeper [6] has published numerous articles on the subject of oxalic acid in gout in the last ten years, and his experience has demonstrated more and more the pathogenic action of retention of oxalic acid. It affects the liver, muscles, and nervous system, but the joints suffer first. It involves mainly the small joints of the hands and fingers, settling in connective tissue and bone rather than the cartilage and periarticular tissue for which uric acid displays a predilection. Uric acid gout is accompanied by vasomotor congestion and high blood pressure,—oxalic acid gout by low blood pressure and anemia.

Other symptoms of oxaluria are neuralgia, eczema, dyspepsia, nervous exhaustion and mental distress.

[6] *J. A. M. A.*, Sept., 1921.

CHAPTER VII

DIET IN THE COMMON DISEASES

In the previous chapter the sixteen rules were outlined which may prevent the majority of the acute and chronic organic diseases and possibly some of the infectious and deficiency diseases. When once these have gained a foothold, the question of diet must always be of the utmost importance, based upon the etiology of the particular disease; sometimes the same disease is produced by entirely different causes, and the diet in these cases would naturally be somewhat different. (Certain type of diabetes and anemia for example.)

Hyperchlorhydria.—Chronic cases of hyperacidity are extremely common and the question of the diet has provoked much controversy. Some authorities advocate a high protein diet because the protein combines with the free hydrochloric acid and therefore diminishes the gastric acidity. Others advocate a lacto-vegetarian diet, and still others a carbohydrate diet based upon the experiments of Pawlow, which show that the gastric secretion is less stimulated by these substances than by protein. Von Noorden and Zweig are in favor of a mixed diet as they claim that neither protein nor carbohydrates have any appreciable effect upon the gastric acidity.

The following diet has been carried out with success in the author's experience:—

1. Avoid drinking with meals as water stimulates the flow of gastric juice.

2. Avoid all flesh because it demands much hydrochloric acid to reduce it to peptones.

3. Avoid condiments, tea, coffee and large amounts of cane sugar for reasons previously given.

4. Eat little salt as this stimulates secretions.

5. Avoid acid fruits. Eat ripe bananas, prunes, figs, dates, raisins, plums, pears, watermelon, grapes and baked apples.

6. Eat easily digested fats, such as olive oil, butter, nut butters, ripe olives,—perhaps Yogurt buttermilk and eggnog.

(Fats inhibit the flow of hydrochloric acid.)

7. Foods should be taken in the form of a purée (vegetables, cereals and legumes) as chewing stimulates the flow of gastric juice.

8. All cereals and legumes should be allowed as they are an important protein food and also contain much required carbohydrate.

9. All roots, tubers and vegetables should be advised because of their high mineral and vitamine content.

10. Eating little at one time should be urged in order that the food may pass out of the stomach as quickly as possible. Four meals a day may be given if necessary when the meals are small.

Hypochlorhydria.—The majority of the rules are opposite those for hyperacidity.

1. Highly peptogenic foods should be eaten as they demand much hydrochloric acid. These include cereals, legumes, nuts and eggs. The cereals and legumes should be served whole and cooked only a short time, and they should be thoroughly masticated.

2. Roots and tubers should be eaten with the skins, especially baked potato. There should be a liberal supply of fruits and vegetables, eaten in the raw state as far as possible, which requires more thorough mastication than when these foods are cooked, thereby stimulating secretions.

3. Avoid quantities of fats which inhibit hydrochloric acid.

4. Avoid tea, coffee, condiments, meats, cheese and cane sugar for reasons previously given.

5. In some cases pure culture buttermilk may be advised.

Anachlorhydria.—Foods should naturally be advised which make little demand upon the stomach. Small meals and probably four a day will prove most beneficial.

The following foods have given good results:—

Buttermilk (pure culture).

Rice in all forms.

Tapioca.

Wheat flakes (with sterilized milk or cream if desired).

Corn flakes. (Ripe fruits are excellent in place of cream.)

Raw eggs (may be beaten and added to fruit juices).

Pulp of potato.

Purées of peas, beans and lentils.

Vegetable broths.

Vegetable purées.

Ripe fruits (according to the patient).

Colitis—Gastritis—Gastric Ulcer—Appendicitis—Enteritis.—All require practically the same diet except gastric ulcer and acute appendicitis, when generally the initial nourishment should be given per rectum. Rectal injections of glucose every other day may be given and sterilized milk and raw egg can be given every day.

At first give only water and vegetable purées orally. Gradually other foods are added. Olive oil can be given to the amount of 150 c.c. a day. Two to three eggs a day may prove of benefit in the later stages. Strained cereal gruels, potato and rice purées, cauliflower and lettuce purées and ripe fruit juices have given good results.

Migraine.—This may be the result of a high protein diet, arteriosclerosis, great muscular or brain fatigue and other causes.

Follow the diet rules according to the etiology.

Dilatation — Flatulency — Heart Diseases. — Disinfect the stomach and intestines by giving a diet of fruit juices and water for two days. (This may be omitted in heart diseases.) A dry dietary is advised because it promotes mastication, and therefore prevents overloading the stomach. Small quantities of food should be given four times a day, and no water allowed with the meals.

The following foods are especially advised:—

Prepared dry cereals	Nuts
Toast	Raw fruits
Corn bread	Whole-grain wheat
Baked potato with skin	Raw vegetable salads
Figs — Dates — Raisins —	Popped corn
Prunes (washed and uncooked)	

Gall-stones—Jaundice.—The following diet may sometimes obviate an operation. The great aim is to stimulate all secretions through reflex action.

Four hundred grains of cellulose (or approximately one ounce) a day may be advised.

A generous amount of water probably will prove beneficial.

A laxative diet gives good results, consisting of fresh vegetables, and fresh fruits eaten without paring, olive oil, unrefined cereals cooked a very short time, legumes, roots and tubers with the skins, and nuts.

The following table will give the approximate number of ounces of foods necessary to furnish 400 grains of cellulose. These figures can be compared with those recommended in Europe in what is called the grape cure for auto-intoxication, acne and allied diseases. In this cure about 6 pounds of grapes a day are given, approximately 96 ounces. Naturally many of these figures are high because of the high per cent of water in fruits and vegetables.

A variety of the following foods each day should make up the sum total:—

Raw	Ounces Give 400 Grains Cellulose	Raw	Ounces Give 400 Grains Cellulose
Asparagus	76	Plums	53
Beans	100	Cherries	40
Beets	76	Red Raspberries	108
Brussels Sprouts	54	Huckleberries	6.5
Cabbage	44	Blackberries	16
Carrots	80	Strawberries	40
Cauliflower	82	Currants	23
Celery	57	Bananas	226
Green Peas	43	Figs	18
Lettuce	114	Apricots	32
Onions	115	Cranberries	16
Parsnips	45	Polished Rice	200
Dried Peas	14	Unpolished Rice	109
Baked Potato	73	Corn Meal	40
Tomatoes	99	Corn Flakes	40
Turnip	61	Dried Beans	100
Prunes	40	Dried Peas	13
Apples	80	Lentils	20
Pears	27	Graham Bread	67
Peaches	80	Sterilized Bran	2

Diarrhea (Adults')

Only water for 24 hours in severe cases.

Rice
Rice Flakes
Rice Pudding
Cornstarch Pudding
Tapioca Pudding
Purée of Lettuce or Cauliflower
Cereal Gruels
White Bread Toast
Albumin Water
Cocoa
No Sugar

Colon irrigation and Pluto water may prove advisable at the onset.

Diarrhea (Infants').—There are several varieties of acute infants' diarrhea. One is caused by the dysentery bacillus,—B. dysenteriæ (Flexner), B. dysenteriæ (Shiga), B. dysenteriæ (Kruse),—another by a gas-forming bacillus, the B. aërogenes capsulatus, and very recently [1] another type has been described by K. Mita of Fukuoka, Japan,—that produced by the paratyphoid bacillus and the paradysentery bacillus. In the B. dysenteriæ types, albumin water may prove beneficial (white of one egg to one cup of water 3–4 times a day); give plain cool water also. In the B. aërogenes capsulatus variety, cereal waters and fruit juices may prove beneficial.

Diarrhea in infants may also be due to over- or under-feeding, to a mechanical obstruction, to some particular infection or to fat intolerance. If fermentation is the cause (albumin water is recommended), it is confirmed by the frequent, green, watery stools.

If diarrhea is due to overfeeding or to some particular infection, give only water for twelve hours, and a table-spoon of mineral oil, "Milk of Magnesia," or Pluto water, or sufficient to cause a complete evacuation of the colon.

If fat intolerance is the cause, give fat-free milk, perhaps modified with oatmeal water (oats contain an easily digested fat) and olive oil, which gives excellent results in many cases. (See Modification and Schedule, Chapter VIII.)

Calcium caseinate milk has been employed in cases of fermentation. This is low in carbohydrate and fat. A. G. DeSanctus and L. V. Paider of New York give the following formula [2]:—Two-thirds ounce calcium casein is used to 16 ounces of whole milk and 16 ounces of boiled water. It is well to use ⅓ milk and ⅔ water for infants under four months (10 ounces milk to 20 ounces water). Mix the calcium casein with 4 ounces of cold water. Bring

[1] *J. Infect. Dis.*, Dec., 1921.
[2] *Arch. Pediat.*, April, 1921.

the milk to a boil and add the calcium casein and boil 5 minutes. Strain, and add 16 ounces of boiled water.

Other authorities have found pure culture lactic acid milk beneficial in underfed infants.

Kidney Diseases.—The great aim is not so much to spare the kidney cells as to correct the cause of the disease. Wordley has demonstrated that variations in the amount of protein in the diet have no effect on the amount of albuminous matter excreted in the urine. Bacteria and toxins are the chief causes. Von Noorden has concluded that an exclusive milk diet advocated by many physicians in cases of albuminuria produces very harmful results such as stenocardia attacks, ocular disturbances, etc. He recommends an average amount of water, which is contrary to many authorities.

Rice has also been greatly recommended because it is so easily digested and leaves no residue. The author's conclusion has been that quantities of polished rice and an exclusive milk diet would tend to promote albuminuria because of the high protein content in the milk and the low mineral, vitamine and protein content of polished rice. A high protein diet with lack of mineral matter, vitamines and cellulose probably is the cause of the majority of kidney diseases. The explanation is found in the chapter on Auto-intoxication.

The following rules have produced excellent results:—

1. Average amount of water between meals or a very little with meals.
2. No meat, fish, fowl or game.
3. A moderate amount of eggs (one a day if desired), but they are not necessary.
4. Peas, beans and lentils as desired.
5. All cereals are allowed.
6. Roots and tubers are allowed.
7. All fresh vegetables are excellent, spinach excepted.
8. All fresh fruits are excellent, rhubarb excepted.

9. Prunes, figs, dates and raisins as desired.
10. All kinds of nuts as desired.
11. Very little cane sugar.
12. Little or no tea, coffee, milk or condiments.

Gout.—The diet is practically the same as that recommended for kidney diseases. In this disease uric acid or oxalic acid is deposited in the joints in the form of urates or oxalates and for this reason, foods that produce purines and calcium oxalate should be more restricted. It is because of this fact that legumes are often forbidden. Gout is accompanied by flatulency, high blood pressure, neuralgia and constipation, and sometimes by low blood pressure and anemia; all these complications will be benefited by the diet recommended for kidney diseases. (See Rule 11; Spinach and Rhubarb, Chapter VI.)

The following foods are very rich in purines:—Sweetbreads, liver, kidney, sardines, yeast.

Foods containing purines in moderate quantities are:—Beef, veal, mutton, pork, tongue, chicken, goose, fish, caviar, oysters, crab, lobster, spinach, peas, beans and lentils, tea, coffee and cocoa.

There is a small proportion of purines in lettuce, radishes, cauliflower, celery, asparagus, potatoes, carrots and string beans, but not sufficient to eliminate them from the diet for gout. Cereals, nuts, eggs and fruits are practically free from purines.

Pernicious Anemia.—There have been many theories regarding the etiology of this disease. Whatever the cause, diet is of primary importance, and should the disease be produced by the B. aërogenes capsulatus, Balantidium coli (A. H. Logan), [3] or other parasite in the intestines, which some authorities claim manufactures a hemolytic toxin, then the diet becomes a still greater factor in the questionable cure of this disease. In this case, raw foods should be chosen as far as possible, and no sweet

[3] *Am. J. M. Sc.*, Nov., 1921.

milk, eggs or meats should be allowed. In certain cases of pernicious anemia, some eggs and pure culture buttermilk may be given. Inorganic iron may be recommended, although it has been a much disputed question whether inorganic iron is assimilated. Some authorities claim it is undoubtedly absorbed to a certain extent, and if so, probably produces the best results in anemias other than pernicious anemia. The interpretation of this fact is that the cause, and not the result of pernicious anemia should be the all-absorbing problem. If, however, certain organisms in the intestines should be one of the causes, then, in reforming the intestinal flora, inorganic iron might be a beneficial factor. An acid medium in the colon will antagonize these forms of life, and, therefore, should be produced through diet.

Quantities of lettuce, cabbage, lentils and oatmeal should be given, and the other unrefined cereals and legumes at times. To these, add nuts well masticated, and a very generous quantity of the fruits and vegetables rich in iron, given in Chapter III, the latter prepared in salad form, including lettuce, cabbage, tomatoes, cucumbers, onions, celery, radishes, watercress, etc.

A cathartic may be advisable at the beginning of the treatment, and only a limited quantity of fruit juices allowed for 24 hours, keeping the patient in bed.

The Bulletins of The Johns Hopkins Hospital have been publishing during the last few years some interesting data on pernicious anemia, but the studies are not conclusive.

"In anemias [4] of various types the protective power of the serum is diminished, and is most marked in anemias which are hemolytic in character, and in conditions in which the spleen is involved."

This statement appeals to the author as a further proof that the disease is caused by a bacterial toxin, since in

[4] Bull. Johns Hopkins Hosp., Oct., 1921.

mammals a great number of the specific antibodies are made in the spleen. Professor Preston Kyes [5] has been conducting this extremely interesting research. Professor Kyes found that in immunized rabbits to certain antigens (infectious organisms and other foreign protein bodies), the antibody content of the spleen was one hundredfold the antibody content of the serum.

D. H. Morris and F. D. Bullock [6] say the work done regarding the relation of the spleen to infectious diseases is fragmentary, unconvincing and conflicting. Concerning work hitherto done, the most convincing is that of Pfeiffer and Marx. They claim that while removal of the spleen prior to the immunizing process did not prevent the formation of immunity, it was found that if the immunization was attempted before splenectomy, immunity failed subsequently to develop. These results of Pfeiffer and Marx for cholera have been confirmed by numerous other observers.

Splenectomized animals can weather a critical disease, but in this case the bone marrow or the lymphatic system probably compensate for the loss of the spleen.

The blood changes can be said to furnish positive evidence of an impaired ability on the part of the body to resist infection, and it seems possible that the anemia and leucocytosis which are temporarily observed are an indication of increased susceptibility to infection.

The work of Hektoen points strongly to the spleen and other lymphatic tissues as being concerned in the production of lysins, agglutenins, opsonins and precipitins.

One type of the B. influenzæ produces a hemolytic toxin, and streptococci [7] from the throats of scarlet fever patients produce such a toxin. If these two types of bacteria, as

[5] *J. Immunology,* Feb., 1916; *J. Infect. Dis.,* Sept., 1915, and March, 1916.

[6] *Annals of Surgery,* Nov., 1919.

[7] Bull. Johns Hopkins Hosp., Oct., 1921.

examples, produce a hemolytic toxin, is it not reasonable to assume that another variety of bacteria produces pernicious anemia, especially since this disease is most grave in cases where the spleen is affected which produces probably the majority of antibodies in mammals? For this reason it seems advisable to try to eliminate the questionable organisms from the intestines as far as possible, going on the supposition that they can produce a hemolytic toxin which is absorbed into the blood, which may produce this type of anemia. The diet recommended will prove of benefit in either case, and may aid the spleen in its production of antibodies for another variety of bacteria producing a hemolytic toxin elsewhere, causing this disease. In other words, choose a diet which will give the spleen every possible opportunity to manufacture the specific antibodies within its power for this disease, and broadly speaking, for every infection.

The persistent absence of hydrochloric acid is practically a constant finding in cases of pernicious anemia. It is often present years before the blood shows any of the typical changes. For this reason the disease should be suspected in its infancy and preventive measures undertaken. (See S. S. Zilva, Chapter IV.)

Fevers.—Tuberculosis,—Typhoid Fever,—Diphtheria,—Scarlet Fever,—Pneumonia,—Influenza,—Measles,—Whooping-Cough,—Bronchitis.

The terrible wasting, caused by toxins acting upon the cells, which results from fevers, may be prevented by a free use of carbohydrate, for it spares body protein and fat. It also has the advantage of not producing putrefaction in the colon.

Every fever patient should have 8–12 pints of liquid daily—some may be given per rectum.

A diet of fruit juices is excellent, 6–8 pints daily when this is the principal food. This can be given every hour

or five or six times during the day. Malt sugar, 4–6 oz. a day may prove beneficial in severe cases.

As the patient improves, semi-solid foods should be added, such as vegetable purées, potato soup, soft eggs, legume purées, cereal purées and gruels. Gradually add the more solid foods given under the 16 antitoxic rules.

Torry [8] has demonstrated the striking effect of various high-Calorie diets on the fecal flora of typhoid patients. In some cases the addition of 250-300 gms. of lactose a day to the other ingredients of the ration brought about a transformation of the fecal flora from the ordinary type to one strongly dominated by B. acidophilus.

In more recent investigations on dogs he has further established the promptness and uniformity with which they respond to diet changes in their predominant alimentary bacteria.

Contrary to most authorities, it is the author's opinion that milk should not be given in typhoid fever, because it is an excellent culture medium for the typhoid bacillus.

The amount of food and the number of meals a day will depend upon the patient.

In tuberculosis some authorities have advised an ultra liberal intake of food regardless of the digestive disturbances which might result. Forced feedings and a high protein diet so commonly given are decidedly harmful. Not over 60 grams of protein a day should be allowed for a man of average weight.

All the foods included under the 16 antitoxic rules should be given.

Eczema—Asthma—Urticaria.—These afflictions may be the result of anaphylaxis brought about by some special protein in the food. They may be the result of auto-intoxication. Follow the 16 antitoxic rules,—and if necessary eliminate different protein foods with intervals of

[8] *J. M. Research,* Jan., 1919.

time sufficient to prove that the particular food eliminated is or is not the cause.

Diabetes.—Diabetes mellitus has probably always been associated with some form of constipation which existed before the sugar appeared in the urine. This suggests that auto-intoxication may be the probable cause of this particular form of the disease.

Elliott P. Joslin [9] has recently published considerable literature on the association of diabetes with obesity, which again suggests a toxic condition from overfeeding.

It has been claimed by many that too high a carbohydrate diet is the cause of diabetes; others have claimed that too high a protein diet is the probable cause which has overtaxed all the organs and tissues of the body with the result that the liver is no longer able to store glycogen, and the pancreas cannot secrete its internal secretion necessary for the oxidation of the sugar in the blood.

The author's own conclusion is that neither a high carbohydrate nor a high protein diet is the cause, but that the real cause is a combination of a generous meat diet (producing an excess of toxins) with a refined carbohydrate diet, both lacking in mineral matter and in peristaltic stimulation. Lack of vitamines also may play a certain rôle in its causation, as they appear to bear a certain relation to the proportion of the other food principles ingested.

Until recently the diet has been carbohydrate free as far as possible,—and even in the latest literature it has been pointed out by a number of writers that the exclusion of fruits and many vegetables is necessary because of their content of carbohydrate. It is for this reason that some physicians to-day employ the so-called "thrice-cooked vegetables," which are prepared by boiling and draining three times in order to eliminate as much soluble carbohydrate as possible.

The most generally discussed cure is some modified form

[9] *J. A. M. A.*, Jan., 1921.

of the Allen Cure, which is used in hospitals, but which can also be carried out at home.

The main points in connection with this diet are the following:—The patient is put to bed and "starved" for 1–3 days or until sugar free. As soon as the sugar has disappeared in the urine, he is placed upon a 5 per cent carbohydrate vegetable diet, and the diet is gradually increased, perhaps up to the 20 per cent carbohydrate foods. At the same time eggs, meat, cereals, legumes and nuts are given to test the patient's protein tolerance and fats are given to test the fat tolerance. This diet is in no way monotonous,—the principal factor emphasized being to reduce the amount of all foods, and keep the reduction as low as possible, according to the patient's tolerance of protein, fat and carbohydrate.

According to Allen, life, strength and assimilation can be preserved for a much longer time by a degree of undernutrition suited to the severity of the case, and in this connection he emphasizes a limitation of fat in the diet.

The author's conclusion in regard to this diet must be obvious. All meats for diabetics are harmful, and thrice-cooked vegetables are practically worthless with their great mineral, vitamine and carbohydrate loss, and the cellulose robbed of its great value. A certain amount of carbohydrate is absolutely necessary, a certain amount of protein is absolutely necessary, and to a smaller degree a certain amount of fat is necessary, while the vital importance of the mineral matter and vitamines need not be repeated: Raw fruits and vegetables (some may be cooked) are excellent in diabetes for their carbohydrate and mineral salts, the very sweet fruits, especially plums and bananas being excepted. The carbohydrate of potato, oats and the soy bean seems to be particularly well borne in this disease, according to some authorities.

Von Noorden was the first to point out that diabetics were greatly benefited by a diet principally of oatmeal,

perhaps for a week or two. Since his announcement the giving of oatmeal in cases of diabetes has been extensively employed. Large quantities of oatmeal in the diet seem to have the best results in the most severe cases, while in the very mild cases it is not well borne. The soy bean seems to have the same beneficial effects as oatmeal in some cases.

Von Noorden, following the advice of Mosse, has also recommended the potato as an excellent food in diabetes.

The author regards the value of oatmeal in the diet for diabetes as being attributed to the excellent supply of mineral matter, the particular kind of protein, the higher percentage of fat and cellulose, and the somewhat lower proportion of starch, as compared with the other cereals. The following table gives the chemical composition of wheat and oats which will serve to demonstrate the statement just made:—

	Oats	Wheat
Protein	11.8 per cent.	11.8
Fat	5.0 " "	2.0
Carbohydrate	59.7 " "	72.0
Mineral Matter	3.0 " "	1.9
Cellulose	4.5 " "	1.8

The potato may possess a "complete protein" (see Chapter I), although the proportion is very low. Its mineral content is excellent and high.

Soy beans also have a high per cent of a "complete protein." They are also high in fat and mineral matter, having a larger amount than oats. The carbohydrate is about half that found in oats. (See Chemical Composition, Chapter X.)

It would seem that oats and soy beans are much better balanced foods than wheat. This fact may solve the reason in some cases for the excellent results obtained through their use in diabetes. It hardly seems plausible that there can be any special inherent quality in the particular kind

of carbohydrate in these foods. Different starches have different gelatinization points, and some are digested more promptly than others, but they all are reduced to the same simple products in digestion. For this reason it is difficult to reason that one variety of starch can claim priority over that of another in diabetes. There seems to be only one factor that might cause one variety of starch to be superior to another,—that is that lactic acid might be produced in greater amounts from some than from others which would prevent bacterial putrefaction in the intestines, and decrease the amount of toxins that enter the circulation.

Legumes can be given for their protein. A few eggs may be allowed also for their protein. Any of the nuts may be included in the diet for their protein (fat and mineral content), except in the severe cases, when fats must be greatly restricted.

Sajous,[10] the eminent authority on internal secretions, says that diabetes mellitus is characterized by an excessive excretion of sugar which is due to the hypersensitiveness of the test-organ, and to the presence in the blood of waste products or other irritating substances which keep this organ, and through it the adrenals, overactive. An excess of adrenoxidase is thus produced and the intrinsic metabolism of all tissues is correspondingly activated. The pancreas is thus caused to secrete, besides its other ferments, an excess of amylopsin, and consequently the hepatic and muscular glycogens are converted into sugar with unusual rapidity, and the surplus of sugar formed is eliminated by the kidneys. The pancreas is finally destroyed organically through excessive stimulation to the point where its function is inhibited with cessation of the production of the internal secretion from the Islands of Langerhans necessary for oxidization of sugar in the blood. Sajous' conclusion is that disease of the pancreas is not the pri-

[10] "The Internal Secretions and the Principles of Medicine."

mary cause of diabetes, but that the pancreatic lesions are due to overstimulation of this organ.

If this is true, combined with the fact that a surplus of sugar is formed by the body cells, "the prevailing method of depriving the patient of starches and sugars is unscientific. The morbid process being an excessive consumption of these substances in the body at large, including the hepatic glycogen, their withdrawal from the blood can have but one effect, namely, to place at the mercy of the amylolytic triad of the blood what carbohydrate remains in the tissues. The body is thus depleted of physiological components of the highest importance to its welfare. The sugar in the urine naturally diminishes, but this does not prove in the least that the disease is counteracted; it only shows that the patient has been drained effectively of his main sources of muscular heat and energy. Nor does the meat diet to which the patient is relegated protect him against the renal complications feared, since glycosuria is known frequently to persist under such a diet, and to promote the appearance of acetonuria and acidosis. That abstention from starches and sugar is harmful under such conditions is shown by the fact that the restoration of carbohydrates often causes both acetonuria and acidosis to disappear."

To the above objections it may be added that if carbohydrates are withdrawn, the protein of the food is required to produce heat and energy instead of being used for maintaining nitrogen equilibrium. As long as enough sugar is oxidized, there is no harm in a small proportion, or even a considerable amount, passing through the kidneys. The presence of the sugar itself does no harm, but the cause of the sugar does do harm.

Croftan states that in many cases it is well known that the sugar excretion only stops when the amount of meat is considerably reduced. This seems to be in line with Sajous' statement that the formation of wastes or irritat-

ing substances finally destroys the normal functioning of the organs of the body.

It is also known that 58 per cent [11] of protein is available as dextrose in metabolism (casein and a few others excepted), which fact would further account for the appearance of sugar in the urine on a protein diet. There is no necessity for a carbohydrate radical in casein since milk contains a large percentage of sugar.

Croftan further states that withdrawal or reduction of meat appreciably increases the tolerance of carbohydrate. He urges, moreover, "that the chief danger incident to complete withdrawal of carbohydrates is . . . acidosis and coma," and also "that it is surprising how often the administration of a little carbohydrate in cases that are on a rigid diet, or of added carbohydrate in cases that are receiving only small quantities of carbohydrate will cause all these dangerous phenomena to disappear."

Sajous relates that "a lugubrious commentary upon the true meaning of all these facts is suggested by the case of a man in the last stages of the disease observed by Lepine to whom sugar was granted owing to his hopeless condition, and who began to improve. This suggested honey as an appropriate food."

Many authorities advise alkaline mineral water. But if the patient eats fresh raw fruits and vegetables daily, this may not be necessary.

Sajous also defines a second type of diabetes which he calls asthenic glycosuria, due to hypoactivity of the adrenal system, caused by diseases such as gout, syphilis, influenza, by poisons that result from worry, exhaustion or grief and by injury. The pancreas is reduced, therefore, as far as its functions are concerned, to the condition which prevails in the late stage of diabetes mellitus. Diet in this type plays no particular rôle as far as the diabetes itself is concerned.

[11] Bull. Johns Hopkins Hosp., June, 1917.

The author has quoted Sajous at considerable length as his lucid explanation of the causes of diabetes is of great significance in connection with the diet recommended for this disease in this book.

The following recent conclusions of Lenné [12] bear out still further the points emphasized in this disease:—

It is not the purpose of treatment to eliminate glycosuria under all circumstances. Often we must be content if we can get the diseased organism to perform its functions reasonably well so as to improve the general condition of the patient both subjectively and objectively, even though the glycosuria persists. Many patients feel better in every way on a more liberal diet with slight glycosuria than they do on a stricter diet with sugar-free urine. If we recognize the different effects of various proteins on glycosuria, we must not forget that there is also a marked difference in the way various carbohydrates affect different types of patients. Some patients assimilate one carbohydrate better, and some another. For example, it is wrong to assume that oatmeal is going to agree equally well with all patients,—it will be found good for some and bad for others. The same is true of potato starch and rice starch. If on substituting other carbohydrates, it is found that the capacity for improvement in assimilation has been lost, this is the time when further limitation of proteins and the introduction of fast days are indicated, after which the diseased organism takes on new strength, as is shown by a better assimilation of carbohydrates. If such reaction is waited for in vain, in spite of all measures, it is a bad sign.

Dr. W. H. Holmes [13] has published an article in which he simplifies the method of calculation of protein, fat and carbohydrate of Dr. R. T. Woodyatt by the preparation of tables which will prove of value to those interested in the subject of diet in diabetes.

[12] *J. A. M. A.*, Oct., 1921.
[13] *J. A. M. A.*, Jan., 1922.

He states that, according to Woodyatt, the ratio of the higher fatty acids to glucose in the diabetic diet should be as 1.5 is to 1. if acidosis is to be avoided, and that 1 gm. per kilogram body weight is necessary to maintain nitrogen equilibrium.

The total glucose tolerance is roughly the amount of glucose in the carbohydrate foods, plus 58 per cent of the protein and 10 per cent of the fat, minus the amount of glucose eliminated in the urine.

Arteriosclerosis.—The diet should be practically the same as that for diabetes with emphasis laid upon reducing the amount of food as far as possible.

CHAPTER VIII

INFANTS' DIETS; CHILDREN'S DIETS

The literature on the subject of infants' and children's diets is most confusing. There are very few authors who agree on the diet for a bottle-fed infant, whether the infant has a normal digestion or one that falls into the category of the many abnormal varieties common in infancy.

The great desire in this chapter has been to reduce confusion to a minimum as far as possible, and to present the subject in a concise form, with scientific reasons for all conclusions, although the author is fully aware that the conclusions may fall short of the truth.

The great difficulty with the question of bottle-fed infants lies in the fact that it is necessary to give a food that nature did not manufacture for the human infant. Some modification is therefore required, but the human infant's digestive tract is not adapted even to the most perfect modification. Infants possess many idiosyncrasies, and the natural consequence is multiple variety and formulas for modifications of milk, each aiming to satisfy the particular demands of each individual infant deprived of mother's milk. Confusion in this subject is inevitable, and the author makes no attempt to outline a diet for the innumerable individual cases that require special formulas. The aim in this chapter is to give modifications and diets that suit the normal infant deprived of mother's milk, with a few suggestions for some difficult cases. There are many normal cases which have been diagnosed as difficult, simply because the right modification was not used in the beginning.

The difficulties in connection with the diet of an infant should not be numerous when the infant is breast fed. If the mother is in good health, the child receives milk that has the five food principles in the right proportion, and milk that is bacteria free. The Bacillus bifidus is in the intestines to combat putrefaction.

But when the mother's milk is lacking in amount or in the proper proportion of the five food principles, complications arise. Cow's milk or milk from some other animal must be resorted to in part or in whole, a food for an entirely different kind of mammal. This means a great change in the intestinal flora, and putrefaction of some kind takes place, and the way is paved for the numerous ailments and diseases of infancy and childhood. Faulty diet on the mother's part generally is to blame for inferior quality or lack in quantity in her milk.

If mother's milk is lacking *only* in quantity, it should be *complemented* by modified milk,—that is, the infant should receive breast-milk from one or both breasts, emptying them *completely,* and then enough bottle-milk to *complete* the feeding. Through this method, there is a *greater production of mother's milk* than if the infant is given a certain number of breast feedings, and then a certain number of bottle feedings a day.

J. C. Drummond and K. H. Coward [1] state one preliminary experiment shows that the winter feeding of cows may have the effect of lowering the food value of the milk unless considerable care is exercised in the selection of the animal's diet. The natural conclusion is, if this is true, human milk can be altered in the same way.

G. A. Hartwell,[2] experimenting with rats, concludes excess protein in the mother's diet probably alters the composition of the milk, and after a time causes the milk supply to cease. Excess carbohydrate appears to have no

[1] *Biochem. J.*, Nov., 1920.
[2] *Biochem. J.,* Vol. XV, No. 1, 1921.

effect. Excess fat in the mother's diet has a slightly depressing effect on the growth of the litter, but the absence of fat seems to make practically no difference. (According to these experiments, excess protein in the mother's diet may be responsible for the large number of infants deprived of mother's milk.)

A comparison of cow's milk with human milk will emphasize the inevitable results following the use of cow's milk.

	Cow's Milk	Human Milk
Water	87. –88. per cent.	87. per cent.
Protein	3. – 3.5 " "	1.6 " "
Fat	3.5– 4.5 " "	3.1 " "
Carbohydrate	4. – 5. " "	6.2 " "
Mineral Matter	.7 " "	.27 " "
	Reaction Amphoteric	Reaction Slightly Alkaline

It will be noticed that human milk is lower in all the food principles but one. This is the sugar. The question of primary importance is,—how similar to human milk can cow's milk be made? An attempt will be made to answer this question in detail.

The superiority of cow's milk in these food principles is due to the more rapid growth of the calf. The calf doubles its weight in seven weeks; the human infant requires six months to double its weight.

This pertinent comparison can be carried to the milk of other animals. Rabbit's milk contains three times as much protein as cow's milk and five times as much calcium and phosphorus, and the rabbit doubles its weight in six days.

In this connection it is highly interesting to note the composition of the milk of other animals given by König (Hammarsten and Hedin). (See p. 99.)

Under the fat is included also the lecithin, and the proportion of lecithin is greater in woman's milk than in cow's milk. The reason for this is that the infant requires this

	Water	Protein	Fat	Sugar	Salts
Dog	754.4	99.1	95.7	31.9	7.3
Cat	816.3	90.8	33.3	49.1	5.8
Goat	869.1	36.9	40.9	44.5	8.6
Sheep	835.0	57.4	61.4	39.6	6.6
Cow	871.7	35.5	36.9	48.8	7.1
Horse	900.6	18.9	10.9	66.5	3.1
Ass	900.0	21.0	13.0	63.0	3.0
Pig	823.7	60.9	64.4	40.4	10.6
Elephant	678.5	30.9	195.7	88.5	6.5
Dolphin	486.7	——	437.6	——	4.6
Whale	698.0	94.3	194.0	——	9.9

substance for muscles, blood corpuscles, blood plasma, lymph, bile, bone marrow, spinal marrow, and for the development of the nerves and brain, especially the myelin sheath of the motor nerves, which [3] may serve to prevent the spreading of impulses from one fiber to another and as a medium of nutriment for the axis cylinder. A calf, however, is born with its nervous system practically developed. Its movements are coördinated, and it can go after its food and kick with a purpose in mind.

According to Burow, there are 3.05 parts of lecithin to every 100 parts of protein in human milk, and only 1.40 parts to every 100 parts of protein in cow's milk.

Levene and Rolf [4] of the Rockefeller Institute for Medical Research have published some interesting results concerning lecithin in the brain. It has the same composition as that of egg yolk. Lecithins differ in the character of their fatty acids.

The question of the lesser amount of lecithin in woman's milk is a serious problem as this deficiency has not yet been made up in the modification of cow's milk.

The author had considered the addition of a small

[3] Albert P. Mathews, "Physiological Chemistry."
[4] *J. Biol. Chem.*, May, 1921.

amount of egg yolk, using in this case a little less cream in the modification, or legume water in place of cereal water to supply the desired lack of lecithin in cow's milk. But circumstances prevented the completion of this experiment. The egg yolk might also furnish certain amounts of required amino-acids, from the albumin and vitellin, which are low in cow's milk, and iron which is low in modified cow's milk. (See page 135.)

The following table gives the amounts of lecithin in the cereals and legumes according to Bunge:—

One hundred grams dried substance yields milligrams lecithin as follows:—

Peas	1050	Barley	470
Lentils	1700	Rye	570
Beans	1000	Corn	250
Wheat	430	Buckwheat	530

The yolk of a hen's egg weighs about 15 grams, of which, according to Parke, 471.9 parts are water and 528.1 parts are solids. Of these solids, 107.2 parts are lecithin.

Not only does cow's milk contain a much greater proportion of protein than woman's milk, but the proteins differ in themselves. There are two kinds of protein in milk,—casein and albumin. Cow's milk contains six to ten parts of casein to one part of albumin, while human milk contains only two to five parts of casein to one of albumin. According to Szontagh, cow's milk casein develops paranuclein in the stomach, while human milk casein does not. The casein from human milk is precipitated with greater difficulty in the stomach, and the clot formed from it is not tough and large as in cow's milk, but small and flocculent. This advantage will be discussed in detail further in the chapter.

The fat in the two kinds of milk also differs. The fat of human milk, according to Ruppel and Laves, is poorer in volatile fatty acids, and the non-volatile fatty acids consist of one-half oleic acid, which is a larger proportion

than is found in cow's milk; therefore, the fat of human milk has a lower melting-point and is more digestible than that of cow's milk. In human milk 2.5 per cent of the total fat consists of volatile fatty acids and in cow's milk 27 per cent of the total fat consists of these acids. It is for this reason that some physicians are recently advocating the use of olive oil in modified cow's milk. This consists almost wholly of triolein and tripalmitin and is free from the volatile fatty acids found in so large an amount in cow's milk. The proportion recommended is 1 teaspoon to every 4 ounces of whole milk. (See schedule in this chapter for milk modification for bottle-fed infants.) Should diarrhea or vomiting appear, the fat should be reduced.

Many investigators have analyzed the mineral matter in cow's milk and woman's milk. Bunge's figures are often quoted. The mineral matter of human milk is much better assimilated by the nursing child. Calcium and phosphorus are present in much smaller amounts in human milk, there being six times as much calcium and three times as much phosphorus in cow's milk. In human milk the phosphorus is almost entirely in an organic form, while in cow's milk less than one-half is in this form. In view of the fact that phosphorus is extremely necessary to the infant, and that the organic compound is much more easily assimilated than the inorganic compound, it must be admitted that the difference in this respect is a serious one for the bottle-fed infant.

The only food principle that is the same in kind in the two species of milk (water not considered) is the milk sugar, but in quantity human milk is superior. The enzymes, internal secretions and vitamines all have their differences. In other words, a truly humanized cow's milk is an absolute impossibility. New modifications arise every year, but all fall short of the perfect food for the human infant.

For these reasons the author concludes that "the milk of one species of mammals cannot be substituted for that of another without injury. The child that is bottle-fed is apt to prove a weakling, an easy prey to the diseases of childhood, and an heir to the many diseases of adult life."

But if cow's milk is absolutely necessary for an infant, how should it be prepared and modified? Some authorities say it should be given raw, others say pasteurized, while still others say sterilized. In connection with these important questions, most of the authorities say it should be modified in some way. In order to understand the differences in these milks, the advantages and disadvantages of each will be considered.

Sterilizing milk means heating it to 110° C. for about five minutes (milk boils at a higher temperature than water).

Czerney and Keller give the following chemical changes produced by sterilization:—

1. The milk sugar is caramelized under the formation of lactic acid.
2. The coagulated casein and albumin are brought by the acid to an early precipitable condition.
3. The rennet action on milk is very much impaired through the fact that the calcium salts are in part rendered insoluble.
4. The milk gases, especially carbonic, are expelled.
5. The ferment action of the milk is destroyed.
6. The fat in part separates from its emulsified state.
7. The lecithin is split up and the more organic phosphorus combinations of the milk are more or less changed into inorganic.
8. Boiled milk undergoes putrefaction, raw milk does not.
9. The taste of the milk is disagreeably changed.

10. The antiseptic and antitoxic properties of the milk are lost.
11. Hydrogen sulphide is recognized if the milk is boiled longer than five minutes.

To the above changes may also be added the bacterial changes, since cow's milk is never sterile by the time it reaches the consumer.

Sterilization destroys all bacteria, including the lactic acid bacillus and all pathogenic bacteria with the exception of certain spores which require a temperature of 120° C. for 15 minutes to destroy them.

In view of all these changes, what are the advantages to be gained in sterilized milk? One of the great advantages lies in the fact that it kills all pathogenic bacteria. The second great advantage is found under the second change given above, for when the rennet action on the milk is impaired, the casein does not form in a tough mass, but rather in a flaky mass which resembles that of human milk in the stomach, and in this form it is much more readily digested.

The disadvantages which result from the sterilization of milk are:—the lactic acid bacillus is killed which antagonizes the putrefying and pathogenic bacteria, and when the former are destroyed, the latter can develop with much greater rapidity; the emulsification of the fat is destroyed, the protein is coagulated, and so is harder to digest; the enzymes and any similar substances are for the most part destroyed, all of which are most necessary for normal health. It is claimed also that sterilized milk produces constipation.

However, when the advantages and disadvantages of sterilization are weighed against each other, the result is in favor of the sterilized milk, for the *worst* objections against it can be overcome in the following ways. To

prevent the multiplication of harmful bacteria because of the destruction of the lactic acid bacillus, sterilized, modified milk should be prepared with the greatest care (see rules for milk modification in this chapter) and should never be used when over 24 hours old. The enzymes and vitamines are for the most part destroyed and constipation may also be produced, but these disadvantages are overcome by the feeding of certain amounts of orange juice, or substitute, starting when the infant is only a few days old, and increasing the amount as the infant grows older. The orange juice has an abundance of these substances destroyed in the milk, either through raising it to the boiling point or through the aging of the milk.

The coagulation of the protein, the destruction of the emulsification of the fat, and the change, in part, of the organic phosphorus into an inorganic form, are objections that cannot be overcome, but these are small in the mind of the author, compared to the objections found in using raw or pasteurized milk.

Pasteurized milk is milk that should not contain over 50,000 bacteria per c.c.

The temperatures and time vary which are used for the pasteurization of milk. Generally it is heated to 60° C. or 140° F. for 20 minutes. Some authorities give 70° C. or 158° F.

Pasteurized milk has the following characteristics:

1. The food principles, namely the protein, fat and mineral matter, are not affected.
2. The enzymes, vitamines and internal secretions are partly destroyed.
3. The clot in the stomach is not made more digestible.
4. It does not undergo putrefaction as readily as sterilized milk as the lactic acid bacillus is not destroyed. (This bacillus is destroyed at 93.3° C. in 30 minutes.)

5. It does not kill the gas-forming bacillus (bacillus aërogenes capsulatus),—also certain alkali and peptonizing bacilli survive.
6. It may or may not kill the tubercle bacillus. This bacillus is sometimes destroyed at 60° C. in 10 minutes, while sometimes a temperature of 70° C. for one hour is required, according to some investigators.
7. It does kill most pathogenic bacteria such as those of diphtheria, scarlet fever, dysentery, cholera, typhoid fever, infantile paralysis, etc.

In view of these changes, what are the advantages to be gained in pasteurized milk? The principal advantage lies in the fact that it destroys most pathogenic bacteria and does not destroy the lactic acid bacillus. The second advantage is the fact that the protein is not coagulated, the fine emulsification of the fat is not destroyed and the organic mineral matter is not rendered inorganic.

The disadvantages in pasteurization are the following:—it does not kill all pathogenic bacteria; it does kill some of the enzymes and similar substances; it does not render the casein clot in the stomach soft and flocculent.

In the opinion of the author, in spite of the fact that there are a few advantages in pasteurized milk, the disadvantages are such that there is no question as to the superiority of sterilized over pasteurized milk.

Raw milk has some of the same objections of pasteurized milk, namely a possibility of containing many pathogenic bacteria and of forming a dense casein clot in the stomach.

Raw milk has in its favor the fact that the food principles, protein, fat and mineral matter are in their natural form, and the enzymes and vitamines are unchanged if the milk is absolutely fresh. But the disadvantages of raw milk, even though certified, are so great in the author's opinion that there should be no question as to the superior-

ity of sterilized milk, with orange juice or its substitute given in connection with it. (See chapter on Vitamines.)

It is interesting at this point to quote some of Dr. Emmett Holt's statements concerning cow's milk.

A calf at birth usually has eighteen teeth, indicating its early capacity for digesting other food than milk. . . . The human infant does not acquire teeth until the seventh or eighth month, a strong suggestion that up to this time, other food is unnecessary for normal growth.

In the case of infants who are *artificially* fed this is a serious question. "Although the defects of cow's milk have not been wholly understood, the great advantages have lately been seen of the earlier use of other articles of diet,—fruit juices, egg, fresh vegetables, beef juice and broth." The author does not recommend the latter two.

Osborne and Mendel in 1914 found that the gain in weight with 9 per cent of the food solids in the form of casein was very low unless cystine (amino-acid) was added, but if the casein was doubled to 18 per cent a normal gain in weight was seen. This important fact may shed light on some failures and successes in infant feeding.

Dr. Holt [5] says:

We once thought we were supplying the infant's protein needs when we gave as much protein in cow's milk as the protein in woman's milk. Evidently we were wrong. It now seems clear that some of our failures were not due to the fact that we were giving too much fat, but that we were not supplying in the protein given the amino-acids required for normal growth.

In other words, the infant requires more cystine for growth than the calf.

[5] *Arch. Pediat.*, Jan., 1916.

In a more recent article,[6] Dr. Holt repeats his conclusions given in the previous article:—Vegetable proteins are low in amino-acids necessary for growth, while animal proteins are much richer in these acids. While vegetable proteins might be sufficient for maintenance, the animal proteins are needed for growth in children. Woman's milk is high in amino-acids, cow's milk is much lower. Therefore it is necessary to give two or three times as much protein as is contained in woman's milk.

It was stated in conclusion that no experiments had been done, nor in fact was it possible to determine the exact protein requirement of growing children.

E. V. McCollum, N. Simmonds and W. Pitz,[7] however, are convinced they have demonstrated otherwise, for gelatin containing 6 per cent lysine, added to a mixture of wheat and oats, does not improve the protein which is lacking in lysine. But the addition of wheat gluten to either wheat or maize kernel proteins supplements them so as to improve growth. They therefore conclude the improvement is produced through a higher protein intake rather than to a supplementary relationship between the proteins, and that results of feeding maize proteins with wheat gluten are of particular interest because of their effect in promoting growth, despite the relatively low lysine content of both wheat and maize proteins.

Through further experiments these investigators have found that gelatin supplements the protein of oats (lacking in lysine), but that zein (the protein of maize) also supplements the protein of oats, although zein is lacking in tryptophane and lysine and is one of the poorest in cystine,—and furthermore that gelatin does not supplement maize.

If gelatin supplements oats, then it should supplement maize, which it does not, and if gelatin supplements oats,

[6] *Arch. Pediat.*, July, 1921.
[7] *J. Biol. Chem.*, Jan., 1917.

then zein should not, and it does,—that is, if the amino-acid lysine is the determining factor.

These research men conclude that in the protein of oats, therefore, these amino-acids are eliminated as being possibly the essential amino-acids determining growth.

The author ventures the suggestion that perhaps the fat-soluble A vitamine, or the water-soluble B vitamine combined with the necessary supply of mineral matter, is the determining factor in these experiments, although it is unquestionably admitted that a balanced amino-acid ration is necessary for growth. However, the argument is interesting, if not convincing, and points to many future researches along this line.

Referring to Dr. Holt's criticism of vegetable proteins given above, the difference between animal and vegetable protein has been explained in Chapters I and III, and it is true that animal proteins are richer in amino-acids and more completely absorbed. But the author cannot conclude vegetable proteins might be sufficient for maintenance, but not for growth, for vegetable proteins contain all the amino-acids found in animal proteins, only in smaller proportions. It is, therefore, only necessary to allow more vegetable than animal protein in the diet to make up the deficiency for growing children, emphasizing that it be obtained from a variety of vegetable proteins to insure securing the adequate amount of each amino-acid. (Chapter VI, Sixteen Rules.)

The author also would not sanction giving two or three times as much protein in cow's milk as is found in woman's milk. This might give the required amount of lysine, or cystine, or other necessary amino-acids, but would also give far too great a proportion of many other amino-acids. Excellent results have been obtained, in the case of young infants, from cow's milk that contained the same amount of protein as woman's milk, combined, however, with cereal gruels, vegetable purées, thin potato and carrot

purées, a small amount of yolk of egg (at the third month) and fruit juices. In some cases that do not gain, a small additional quantity of skimmed milk might be added to the formulas given in this chapter, reducing the sugar, or in place of some of the cereal water, using of course the given quantity of whole milk in each formula as the basis of the modification. (See page 100, Egg Yolk.)

Dr. Holt, while being a firm believer in a high protein diet in the case of cow's milk for infants, lays much blame, in cases of acute intestinal disturbances, to carbohydrates, especially the sugars, and in conclusion states that more fat and protein can be tolerated if the sugar is low.

These variations from the modifications given further in the chapter may prove beneficial in certain cases.

This argument certainly bears significance, and it is the author's opinion that some other foods should always be given in connection with cow's milk, such as ripe fruit juices, vegetable juices and cereal waters when the infant is very young, and also thin legume gruels (strained) and some egg yolk when the infant is three months old. These should be tried one at a time, and in very small amounts which should be increased to several teaspoons if digestion permits. A teaspoon of egg yolk every day may prove valuable for the amino-acids of the protein, for the lecithin lacking in cow's milk and for a better balanced mineral ration than is found in cow's milk for the infant. In other words, quality is as important as quantity in the food principles.

The orange juice or substitute (Chapter IX) should be strained through muslin when the infant is very young. Two teaspoons a day in connection with sterilized milk may be given to a newborn infant, and this amount should be increased each month until at 9 months the infant is receiving 4–5 tablespoons of orange juice or substitute.

Dr. Joseph Brennemann [8] of Chicago has done some

[8] *Arch. Pediat.*, Feb., 1917.

very interesting work in connection with the digestion of raw, pasteurized and sterilized milk. He was fortunate in securing the willing services of a man in whom the vomiting reflex was readily elicited by digital irritation of the fauces. The following results were obtained from his experiments:—

In the stomach the size of the curds of raw milk are sometimes two inches long and one inch thick and they are often hard and as large as a walnut. But if the milk is sterilized, the curds are reduced to the size of a pea and many of the curds are like sand, and the general consistency is very different from the hard and rubbery curd of raw milk.

The curds of pasteurized milk in the stomach are much like that of raw milk.

Even after five hours, the hard curds of raw milk are still found in the stomach. Mucus is found very abundantly, especially after the first half hour and the curds are slippery and covered with mucus, and more or less bound together by it. At the end of a half hour, the stomach contents are neither offensive nor bitter. But after one hour, and even more marked after two or more hours, they have a very offensive, sour, fatty acid odor.

In sterilized milk, the whey is less definitely separated from the curd.

The less the proportion of fat in the milk, the harder and larger are the curds in the stomach; the greater the amount of fat, the longer the milk remains in the stomach and the slower the digestion.

Milk taken very slowly forms a larger curd than when taken rapidly. This is a startling conclusion, but the explanation probably lies in the fact that all the casein has coagulated in a few curds so large that they cannot be returned, for five hours later the curds have been digested to a returnable size.

The greater the dilution with water, the finer are the curds in the stomach.

Alkalies and sodium salts very greatly inhibit coagulation, even may stop it completely if in sufficient amounts.

Precoagulated milk such as buttermilk, pegnin milk or eiweissmilch (Finkelstein) shows very little tendency to recoagulation.

Dried and condensed milks as a rule form a medium curd. Starchy decoctions such as barley water have a very decided influence in lessening the size of the curd, much more than a simple watery dilution.

Soluble carbohydrates such as dextrins and sugars (milk, cane or malt sugar) have apparently no appreciable influence on the curd.

Dr. Brennemann said that after having used raw and sterilized milk each for many years, there was no doubt in his mind that infants are in general harder to feed on raw milk than on sterilized milk, and that the explanation is a physiological rather than a bacteriological one. Raw milk is only in appearance a liquid food. Milk in the stomach must contain finely divided curds in the case of infants. All the therapeutic measures that aim to adapt cow's milk to the baby have one thing in common, and that is to make the large, hard curd more like the small, soft curd of mother's milk. This is the aim in diluted, boiled, pasteurized, condensed, dried, malted, precoagulated by acids or rennin, alkalinized, citrated, whey milks, etc.

Straight milk can be given much earlier when boiled. Commercial pasteurization is not reliable, and pasteurization at home has many difficulties, and only partly solves the bacteriological problem, while the physiological remains unsolved for the most part.

Although sterilization of milk, with the addition of orange juice, solves the most difficult problems in connection with bottle-fed infants, this should not minimize the necessity for procuring clean milk in the beginning. All milk should be as free from filth as possible before sterilization, and this is best accomplished by centrifugally cleansing it of the udder wastes, and other foreign and impure substances it may contain. Most milk is contami-

nated with particles of dust, manure, hair, insects, etc. Some of these float on the surface, while others settle to the bottom. Udder waste, pus and bacteria, together with the greater part of the dirt, are thrown out by the application of centrifugal force, and come out as a slimy mass.

The following points [9] concerning centrifuged milk are briefly outlined:—

1. The insoluble dirt is effectively removed.
2. Cellular elements are removed to a large degree.
3. Bacteria are removed in varying amounts, the larger more readily than the smaller.
4. Clarified milk trends more closely towards typical lactic acid fermentation, while unclarified milk will manifest obnoxious signs.
5. Unclarified milk develops molds in abundance and putrid decomposition.
6. Carbon dioxide develops in abundance in clarified milk.
7. Obnoxious odors are detected in unclarified milk.

Raw milk causes a large percentage of infant deaths from intestinal diseases; it often is the cause of septic sore throat, typhoid fever, scarlet fever, tuberculosis and diphtheria. Certified milk cannot furnish a guarantee, for not only has tuberculosis constantly been found in the cows of certified herds to some extent, but sometimes to a large extent. It is always difficult to keep cows free from udder disease, and sore udders contaminating the milk with streptococci, are dangerous as the cause of septic sore throat.

The following rules are those that in the author's experience have produced excellent results in the case of the average normal infant:—

The modification naturally changes with the individual infant, and with the age of the infant. Some infants re-

[9] C. E. Marshall, *Am. J. Pub. Health*, Feb., 1920.

quire a different proportion of protein, others a different amount of fat, and still others a greater or less amount of sugar. These facts must be determined by the digestion of each particular infant. The following symptoms will serve as somewhat of a guide:—

Emphasis must be given not to feed an infant too often or too fast, since both induce physical disorder. Twenty minutes is none too long for each feeding.

If the infant is overfeeding, regurgitation and vomiting result, and sometimes diarrhea and colic. Vomiting is also caused by fast feeding and the swallowing of air.

Too much fat in the milk produces vomiting, regurgitation, an acid stomach and constipation or perhaps diarrhea. In this case, either reduce the fat or try olive oil (1 teaspoon or less to every four ounces of whole milk used in the author's modification). There generally is much mucus in the stools if the fat has not been well tolerated, and they are formed, and of a light color. Sometimes fat stools are granular.

F. Friedberg and C. Noeggerath [10] describe the remarkable improvement of certain very sick infants when fed with breast milk from which the fat has been removed by centrifuging, especially in cases of decomposition, as well as ordinary toxicosis, the length of time this is fed depending upon the infant.

Too great a proportion of protein in the milk may produce colic, vomiting, curds and much mucus in the stools. The stools are semiformed and often watery. Sometimes the color is olive green with a glossy aspect. There may be alternating constipation and diarrhea. In this case use less milk in the modification and more cereal water with perhaps a little more cream, sugar or egg yolk.

Carbohydrate stools are easier to detect. They are readily stained with dilute tincture of iodin, the particles of undigested starch staining blue or black. The stools are

[10] *Arch. Pediat.*, Oct., 1921.

loose, acid in reaction, and light brown, excoriating and contain much mucus, indicating undigested cereals.

In this case, try different cereals, or less cereal, adding a little more sugar to the mixture.

Indigestion of sugar produces frequent, excoriating, watery and very acid stools. They are green if sucrose or lactose has been used in the modification, and brown if maltose has been used. There may be much gas and flatulence as a result of the fermentation of the sugar.

In this case use a different sugar in the modification (lactose or maltose) and if there is then no improvement, reduce the sugar, or possibly reduce it with the addition of a little more cream or whole milk in the mixture; or use protein milk which may be made by heating and precipitating the casein in a quart of fat-free milk by essence of pepsin or rennin; the resulting curd is rubbed through a sieve with enough water to make one pint. (See also Infants' Diarrhea, Chapter VII.)

Dr. John Howland [11] says,—in prolonged intolerance of carbohydrate, protein milk should be advocated, and continued until the stools are firm, distention is very slight, gas is not in excess, and the appetite is good.

The foregoing symptoms indicate that the problem of feeding a bottle-fed infant is one that should demand the greatest care and attention. The number of stools, their consistency, color and the presence of mucus and blood are all of great significance in relation to the health of the infant. (For further details,[12] see article by Joseph I. Grover of Harvard University.)

Breast-fed infants have from two to four stools a day, while bottle-fed infants have from one to two, and may often skip a day if a laxative is not given. This should be avoided in every case possible. If constipation is present, but otherwise the infant seems in good health, give

[11] *Arch. Pediat.*, July, 1921.
[12] *J. A. M. A.*, Feb., 1921.

more orange juice. If this does not remedy the case, change the milk modification, using perhaps less fat and more milk or sugar, or less fat and less milk and more sugar and cereal gruel or purée. (See Chapter X.)

Evaporated, condensed and malted milks have been in vogue for many years, but they should be regarded as very questionable and used only when better products are not obtainable. They may produce many physical disorders.

In some cases, however, malt soup extracts (a different product from malted milks) may be highly recommended. They have the disadvantage of being high in price, but in difficult cases of diarrhea and constipation with loss of weight, they have often given excellent results.

The use of malt soup extract dates back many years to the days of Von Liebig who first used it for normal infants deprived of mother's milk. His original formula has been abandoned and that by Keller is used to-day for infants suffering from intestinal disorders, either constipation or diarrhea. The directions come with the preparations. It has been employed perhaps more in cases of diarrhea, but is coming to be used more extensively in cases of constipation. Naturally the same formula could not be used in both cases, and so it is modified to counteract either constipation or diarrhea.

Malt soup extract contains 50 to 70 per cent maltose, 5 to 15 per cent dextrin, 5 to 12 per cent soluble protein, 20 to 25 per cent water, and small amounts of potassium carbonate, phosphoric and lactic acids, etc.

Maltose is quickly absorbed and better tolerated than lactose or cane sugar if an infant does not tolerate sugar well. Potassium carbonate is used because human milk contains this in a larger amount than it does the other salts, and because it is probably the alkali that combines principally with acids in acid intoxication which is often the case where milks have not agreed.

In the preparation of the food, wheat water is generally used because it ferments less readily with the maltose than the other grains; and any cereal water prevents mechanically the formation of tough curds. Oats is used in cases of constipation. Boiled, whole milk is added to the preparation.

The presence of potassium carbonate produces good results in the correction of constipation. It has been shown by Holt that loose stools contain a larger proportion of potassium and sodium than constipated stools.

An infant should be started on a weak formula, preceded by starvation and purgation. A case that does well will have no vomiting and will gain weight. If the infant vomits, and this is not controlled by limiting the amount or by giving a weaker formula, or if the infant has loose stools with much mucus, and they give a blue starch reaction to iodin, this food should be discontinued. A little vomiting may be permitted if the infant is gaining. If the infant retains this food, is not constipated, and does not gain in weight, increase the malt soup extract.

From the foregoing discussion, it is clearly seen that, while malt soup extract is a valuable food in certain difficult cases of infant feeding, there is no hard and fast rule concerning its preparation. The directions that come with the preparation must be varied to suit the individual cases. The food should be prepared the same as any other, making enough each time for twenty-four hours' use, and bottling it in as many bottles as there are to be feedings a day.

The following formulas by A. G. Mitchell of Philadelphia will serve as a guide in the use of malt soup extract:—

In the preparation of the soup itself, the amount of flour ordered should be mixed with a small amount of water to make a paste, the rest of the water ordered is added, and this is boiled for twenty minutes. Then the amount of malt soup extract ordered is mixed with this starch and water solution, constantly stirring. The milk ordered should then

be added, and the whole brought to a boil again. Water is added to bring up the amount lost in boiling.

In Dr. Mitchell's [13] work at The Children's Hospital he has used several different formulas which have been found convenient in increasing the percentages. These, with the approximate percentages of fat, carbohydrate and protein are given as follows:—

(Use unrefined cereal flour.—Author.)

Formula A— ½ ounce wheat flour
10 ounces skimmed milk
10 ounces water
1 ounce malt extract

Fat, 0.2 per cent.; carbohydrate, 7.5 per cent. (of which 2 per cent. is starch); protein, 2.2 per cent.

Formula B— ½ ounce wheat flour
5 ounces skimmed milk
5 ounces whole milk
10 ounces water
1 ounce malt extract

Fat, 0.2 per cent.; carbohydrate, 7.5 per cent. (of which 2 per cent. is starch); protein, 2.2 per cent.

Formula C— ½ ounce wheat flour
10 ounces whole milk
10 ounces water
1 ounce malt extract

Fat, 2 per cent.; carbohydrate, 7.5 per cent. (of which 2 per cent. is starch); protein, 2.2 per cent.

Formula D— 1 ounce wheat flour
10 ounces whole milk
10 ounces water
1½ ounces malt extract

Fat, 2 per cent.; carbohydrate, 14 per cent. (of which 5.7 per cent. is starch); protein, 2.9 per cent.

[13] *Arch. Pediat.*, Jan., 1916.

These formulas made with any extract of malt would give about the same percentages.

Barley flour may be used instead of wheat flour in cases of diarrhea. Wheat flour is probably better because the combination of wheat flour and malt extract is least apt to ferment, and produces the smallest amount of acids.

Using the proportions given in these formulas, make up the correct amount of ounces for the twenty-four hours' feeding, and apply to the hour schedule. In other words, make up about one-half again as much for the first and second months' feedings. For example, add $\frac{1}{4}$ ounce wheat flour, 5 ounces skimmed milk, 5 ounces water and $\frac{1}{2}$ ounce malt extract to Formula A. After the second month make up about two times any of the formulas. The correct amount of ounces according to age, and the hour schedule are given under the modification generally used by the author.

The reason for choosing this modification is as follows:

Human milk contains:

Protein	1.5	per cent.
Fat	3.5	" "
Carbohydrate	6.5	" "
Mineral Matter	.2	" "

Cow's milk contains:

Protein	3.5	per cent.
Fat	4.0	" "
Carbohydrate	4.5	" "
Mineral Matter	.7	" "

Cereal water contains:

Protein	.05	per cent.
Fat	.051	" "
Carbohydrate	3.2	" "
Mineral Matter	.015	" "

This percentage composition of cereal water is obtained using the proportion of 2 tablespoons of flour to 20 ounces of water.

By mixing equal quantities of whole cow's milk and cereal water, the average per cent will be:

Protein	1.8
Fat	2.0
Carbohydrate	3.8
Mineral Matter	.35

This makes the proportion of protein about right, but leaves the fat and sugar too low, while the mineral matter is too high. To remedy this lack in fat and sugar, add to every four ounces of the milk, 2 teaspoons of cream, and to every four ounces of the cereal water 2 teaspoons of lactose or maltose, or dextri-maltose.

The resulting mixture is about right, except for a small excess of mineral matter. This defect may be overcome by a very small amount of lime water, although it is the author's opinion that too much lime water is generally used, and it might be well to omit it almost entirely when sterilized milk is employed. While the addition of lime water would seem to tend to increase the mineral content of the mixture, it nevertheless has the opposite effect in relation to absorption, by changing part of the calcium and phosphorus already present in cow's milk from a soluble to an insoluble form. Through this change, the clot in the stomach is made less dense,—this is the purpose of the lime water. But sterilization accomplishes this aim also, and it does not have the questionable result produced by the addition of the lime water of perhaps reducing the amount of soluble calcium and phosphorus in cow's milk to a point below that in human milk.

This problem [14] has been discussed by H. I. Bowditch and A. W. Bosworth through experiments conducted in Boston. An infant requires .18 grams of calcium daily (Schabad). One of the striking differences brought out in comparing cow's milk with human milk is in the amount

[14] *Boston M. & S. J.*, Dec., 1917; *J. Biol. Chem.*, Jan., 1917.

of insoluble, inorganic calcium and phosphorus. There is only a small amount of this in human milk, but a large amount in cow's milk, in the form of insoluble, dicalcium phosphate. It has been found that children over four months can utilize some of this, while younger ones cannot. There is also much soluble calcium and phosphorus in cow's milk.

This fact has special significance in connection with the addition of lime water to cow's milk, as the addition of the lime water results in the precipitation of insoluble, dicalcium phosphate:—

$$CaCl_2 + 2NaH_2PO_4 + Ca(OH)_2 = 2NaCl + 2CaHPO_4 + 2H_2O$$

Therefore it is possible by the addition of lime water to reduce the soluble calcium and phosphorus in modified mixtures to amounts less than those in human milk, which contains these for the most part in an easily assimilable organic form. This fact may have a bearing upon certain abnormalities found in infant feeding.

In discussing [15] the possible effect of the addition of lime water to infant's food, it is interesting to note the results of some investigations by Dr. Alfred Hess and Dr. Lester J. Unger of New York who have conducted experiments to a very large extent in infants' foods. In a recent article they speak of the deleterious effect of the alkalization of modified milk. Orange juice, the prototype of antiscorbutics, is damaged within 24 hours through being rendered twentieth normal alkaline to phenolphthalein. It is evident, therefore, that the antiscorbutic vitamine is peculiarly sensitive to alkalization, more so than the fat-soluble A and the water-soluble B vitamine.

Doctors Hess and Unger cite the following case:—An infant was fed on malt soup extract with cereal water and

[15] *J. Biol. Chem.*, March, 1919.

cod liver oil (rich in vitamine A) and had not been gaining in weight; the potassium carbonate in the formula was discontinued with the result of an immediate gain in weight. Therefore, there is a question as to the amount of potassium carbonate to be used in malt soup preparations. This salt is used in many proprietary foods for infants because it renders the food less subject to acid fermentation, and because it counterbalances the relative poverty of this salt in cow's milk.

Feeding top milk also has produced many evil effects in the author's opinion. Milk should be thoroughly shaken before the correct amount is measured. John Lovett Morse has given some wise counsel on this subject. He asks why physicians have advised top milk and gives the following reasons:—"Many physicians have unintentionally disregarded the teachings of those who have known how to use fat; the erroneous idea prevalent years ago, and long since discarded, that fat cannot do any harm to an infant; the knowledge of the fact that fat may act as a laxative, and the ignorance of the fact that it may constipate; the desire to make the infant gain; the carelessness of physicians in directing mothers how to prepare the food; the laziness of physicians in that they will not take the trouble to learn how to modify milk properly."

All questions considered, it is the author's opinion that sterilized, whole, certified milk, diluted with cereal water, with the addition of sterilized cream, milk or malt sugar, or dextri-maltose, and perhaps ¼ ounce of lime water (about ½ tablespoon to 30 ounces of the mixture) gives the most ideal modification for the normal infant. Orange juice should be combined with this daily, according to the age of the infant, and given between feedings. Soon other juices, and gruels, and egg yolk should be added.

During the first 48 hours, the infant receives practically no nourishment,—about 6 ounces a day at intervals of six

hours. It should be given a few teaspoons of warm, sterilized water. On the third day the regular feedings begin, and the infant should be roused from sleep if necessary.

During the first two months, the feedings should be between one and two, and four and five in the night, but after that, it will require but one night feeding, and after five months, no night feeding.

One to two ounces of sterilized warm water should be given each day to a nursing infant, and three to four ounces, three times a day, should be given a child a year old. The water can be given cool after the third month if it is better relished.

APPROXIMATE GAIN IN WEIGHT, FIRST YEAR (Crozer and Griffith)

First Month	7 oz. a week
Third and Fourth Month..........	5½ " " "
Fifth and Sixth Month............	4⅔ " " "
Remainder of the Year............	3¾ " " "

An infant generally loses in weight up to the third or fourth day, and may not regain its original weight until the fourteenth day.

Milk Modification.—The following steps are necessary in any properly prepared modification.

1. Pure, fresh milk from a healthy cow or herd should be used. It should be kept in the original bottles on ice until the food is prepared, just before which the bottles should be well shaken to mix the top and bottom milk.

   There should be as many nursing bottles as the infant is to be fed times a day, standing the bottles in a wire rack until used.
2. Pour entire quantity of milk into a sterilized pitcher, and from this take the quantity advised in each formula according to the age of the child. Entire quantity for the twenty-four hours should be prepared at once. If possible, use a glass graduate for

measuring in ounces. (2 level tablespoons = one ounce, is a reliable measure for small amounts.)

3. Mix required amount of cereal flour, barley, wheat or oats, using oats if the infant is constipated, about two level tablespoons with a little cold water and a pinch of salt, until the seventh month,—after this double the proportion of cereal flour.
4. Stir cereal paste into 20 ounces of hot water and cook in a double boiler 20 minutes; add enough water to make 20 ounces when finished.
5. Pour gruel into a sterilized pitcher. Add the milk or malt sugar (2 level teaspoons to every 4 ounces), and stir. (Use one-third to one-half this amount of cane sugar if other sugars are not available.)
6. Stand pitcher in cold water until the gruel is 98° Fahrenheit.
7. Take required amount of whole milk while the gruel is cooling, the cream having been added (2 teaspoons to every four ounces) to the milk before it was sterilized.
8. Measure correct amount of lime water (¼ ounce up to the seventh month) and add to the milk.
9. Strain the gruel, pour it into the milk and stir.
10. Pour this modified milk into bottles needed for the 24 hours.
11. Cork bottles firmly with twisted wads of sterilized cotton or white waxed paper fastened on with a rubber band.
12. Cool the bottles by standing the rack in a pan of cold water.
13. Place rack in the ice-box.
14. Stand bottles in hot water before each feeding until the milk is 98° Fahrenheit.
15. Remove cotton or paper, adjust nipple, invert bottle, and test heat of milk on the wrist. (It should be body temperature.)

16. Put on woolen bag to keep milk warm, and serve at once.

Care of Bottles and Nipples.—Always boil a new nipple for five minutes. After using, rinse it in cold water. Each day turn nipples inside out and scrub with warm water and soap and rinse. Keep in a covered cup of borax water. Have as many nipples as bottles.

Immediately after using, rinse bottle in cold water. Wash all bottles for 24 hours' use in hot, soapy water with a bottle brush. Rinse bottles in hot water and boil for twenty minutes. Nipples may be boiled with the bottles as a further precaution. Keep bottles inverted in a wire rack until used.

Olive oil referred to previously in this chapter may be tried in place of the cream if a fat intolerance exists, always using about one-half as much as the amount of cream called for.

If milk or malt sugar are not available, use only one-third to one-half as much cane sugar as milk or malt sugar called for in each formula. Maltose sometimes has too great a laxative effect. Dextri-maltose, generally made from potato-starch, is much cheaper, and, therefore, recommended more for general use.

The orange juice should always be given between feedings, and diluted with boiled water if sour. At the third month it may be advisable to give also juices from the potato, tomato, carrots, lettuce, a teaspoon of egg yolk, and a few teaspoons of legume gruels.

First Month

Milk	15	ounces
Cereal Water	15	ounces
Maltose or Lactose.......	7½	level teaspoons
Cream	7½	teaspoons
Lime Water	¼	ounce (½ tablespoon)
Orange Juice	2	teaspoons a day

One to two night feedings.
Give 3-4 ounces for 7 feedings depending upon the individual child. (Some authorities advise only 6 feedings.)

Second Month

Milk	15	ounces
Cereal Water	15	ounces
Maltose or Lactose	7½	teaspoons (3 level tablespoons)
Cream	7½	teaspoons (3 " ")
Lime Water	¼	ounce
Orange Juice	3	teaspoons a day

One to two night feedings.
Give 4 ounces for 7 feedings.

Third and Fourth Months

(Other foods previously stated may be added.)

Milk	18	ounces
Cereal Water	18	ounces
Maltose or Lactose	9	teaspoons (3 level tablespoons)
Cream	9	teaspoons (3 " ")
Lime Water	¼	ounce
Orange Juice	4½–6	teaspoons a day

Give 4–5 ounces for 7 feedings.
One night feeding.

Fifth and Sixth Months

Milk	18	ounces
Cereal Water	18	ounces
Maltose or Lactose	9	teaspoons (3 level tablespoons)
Cream	9	teaspoons (3 " ")
Lime Water	¼	ounce
Orange Juice	7½–9	teaspoons a day (3 tablespoons)

Give 6–7 ounces for 5 feedings.
No night feeding.

Seventh, Eighth and Ninth Months

Double the strength of the cereal water. Gradually accustom the child to other foods, such as lettuce and carrot purée, potato purée, soft egg yolk and soft, ripe pulp

of raw peaches and pears, and stewed prunes and baked apples, if these foods have not already been given.

Milk	20	ounces
Cereal Water	20	ounces
Maltose or Lactose.......	10	teaspoons (3⅓ tablespoons)
Cream	10	teaspoons (3⅓ ")
Lime Water	½	ounce
Orange Juice	10½–13½	teaspoons a day (About 4–5 tablespoons)

Give 8 ounces for 5 feedings.

Tenth, Eleventh and Twelfth Months

At this age the infant may be weaned. If it is breast fed and doing well, it may be best not to wean an infant until it is a year old. Gradually withdraw either mother's or cow's milk, adding only one new food at a time, allowing enough time between each new food to test the merits of each for the particular infant in question. If a certain vegetable, fruit, potato, egg, etc., does not agree, try another, for each child is a different problem.

Milk	20	ounces
Cereal Water	20	ounces
Maltose or Lactose.......	10	teaspoons (3⅓ tablespoons)
Cream	10	teaspoons (3⅓ ")
Lime Water	½	ounce
Orange Juice	5–6	tablespoons a day

Give 10 ounces for 4 feedings.

Many formulas for the modification of milk are very different from those given above. For instance, some have a much larger proportion of cereal water than milk during the early months, and generally one ounce of lime water is added. As the infant grows older, the milk is gradually increased until it is in a proportion considerably larger than the cereal water. In some cases these formulas might be better, but they do not resemble mother's milk in the percentage of the food principles. A larger amount

of milk may be advisable in some cases in which there is not the normal gain. In these cases a reduction in the sugar may be advisable.

Diet for a Child One Year Old.—The diet recommended by the author for a child one year old is different from that found in the majority of books on this subject. The main difference centers around the elimination of cow's milk as far as possible, other foods furnishing the same nutritive requirements being selected in its place. This is a radical change, and one that is attempted with considerable misapprehension by physicians and mothers. However, if the child is normal, and the foods are chosen with a scientific knowledge, the fears are unfounded, and the child is benefited. The bacterial and dirt problem of cow's milk is solved in its elimination from the diet, and if the child is inclined toward constipation, this problem is also solved. Why do physicians insist on advising an abundant supply of cow's milk to all weaned children, a food suited primarily by nature for the nourishment of the calf, when dozens of other foods in proper combination have every advantage of cow's milk and none of the disadvantages? We read, "No child should receive less than a pint of milk a day." The milk question is universally considered a serious one, and every day literature and text-books are filled with its problems.

M. J. Rosenau has written a book of about three hundred pages on the problems of this food. He asks,—"Why do we have a milk question?" He answers the question by saying that "milk is apt to be dangerous to health,"—and that "we cannot do without milk." He further states that "it is the most difficult of all our standard articles of diet to obtain, and handle in a safe and sanitary manner. Milk decomposes more quickly than any other food. It is probably accountable for more sickness and more deaths than all other foods put together. There probably is no single problem in the whole realm of modern sanitation

and hygiene that is so complex, so involved, so intricate and so harassing."

The author admits that this question is more or less difficult in the feeding of children whose parents have no knowledge of the chemistry of foods, and their digestion, and the requirements of the healthy body. But this fact is what has been lamented elsewhere in this little volume, for this knowledge should be a requirement, and not omitted or optional, in the education of every young man and woman. If milk is responsible for more sickness and deaths than all other foods combined, surely it should be eliminated from the diet after the nursing period,—and if used at all, it should be sterilized. There is not the slightest question that substitutes for milk can be used in the diet after the nursing period, but custom and habit are such dominant factors in the daily life of man that it is well-nigh impossible to omit milk from the diet for children and adults.

W. W. Cadbury,[16] of Canton, China, writes that "milk, butter and cheese are rarely used in China,—children grow strong without milk. Rachitis practically is never seen. When an infant is weaned he is given rice gruel."

In eliminating milk from the diet after the nursing period, the author would not recommend so limited a diet as that on which the Chinese children are raised. Variety of the right kind of foods is a safeguard against all diseases, but the fact remains, nevertheless, that the Chinese children have been raised for centuries on a very limited diet with the exclusion of milk.

The question is often asked,—why does a person who has been put on a milk diet because of a "run-down condition" gain? Such a person probably has been on a meat and high protein diet, and a change from this always would prove beneficial. Should this same person be put on a diet consisting of the legumes, cereals and nuts as the protein

[16] *Am. J. Dis. Child.*, Jan., 1920.

foods, combined with tubers, raw fruits and vegetables, the benefits would probably be even more pronounced. (See Milk, Chapter III.)

In discussing the value of milk for children, especially in connection with cereals, one writer makes the following statement:—

Cereals produce phosphoric and sulphuric acids in digestion, and these must be neutralized or an acidosis will result. Milk, which contains a large quantity of lime, is most valuable for neutralizing the acids produced from the cereals.

Such an argument fails to convince, because protein is absolutely necessary for life and almost every protein contains sulphur and many of our most valuable foods contain phosphorus including milk itself. Milk contains much lime, but fruits and vegetables also contain much lime, and as has been explained, should be relied upon for their mineral content and neutralizing power. Milk has the many disadvantages already enumerated, while fruits and vegetables possess none of these. The author of the above remarks seems to be unmindful of these important facts. (See Calcium and Carrots, Chapter II; Milk, Chapter III.)

A very excellent dish for either children or adults is some cereal, to which has been added a fresh fruit,—oranges, berries, etc., or dates, stewed prunes, raisins, etc.

The majority of books on this subject also advise against short periods of cooking of cereals and vegetables, and lay emphasis on prolonged and thorough cooking of the starches. This the author has also found to be unnecessary. Instead of cooking cereals one to three hours, cook them perhaps one-half hour or as long as necessary to soften them sufficiently to rub through a very fine purée sieve for the child one year old. (See Chapter II.)

Short periods of cooking starches sometimes produce a slightly laxative effect because of the fact that less of the

starch is assimilated, and as a result lactic acid may be produced from it in the colon, but this is to be desired unless the symptom is too pronounced. Short periods of cooking the cellulose of cereals and vegetables may also produce the same effect. (See Chapter II.) If the laxative effect is too pronounced, longer periods of cooking may then prove beneficial, but two to three movements a day are beneficial if not too loose.

If the diet of fruit juices, thin purées of succulent vegetables, unrefined cereal gruels, thin legume purées, roots and tubers, and soft boiled eggs proves a too laxative diet for a particular child of this age, then sterilized, certified milk can be given for such a period as this symptom of the child demands.

Again, almost every authority advises the giving of meat broths and meats. According to the author's conviction it is a great mistake to give these foods to young children whose glands of internal secretions are undeveloped, which aid in destroying the bacterial poisons generated in the intestines, and which are absorbed and circulate through the entire system.

Meat broths are not only food for bacteria in the intestines, but they are worthless as far as the question of any nourishment is concerned. This is contrary to the accepted idea. They are practically nothing but water laden with waste products,—urea, uric acid, xanthine, creatine, creatinine, etc., and a very small amount of salts and gelatin. Some of the nourishment has been drained off in the blood, and the muscle fiber and other proteins which furnish nutriment are not present in broth. The very small percentage of mineral matter and protein in meat broths can be supplied far better in many other foods.

The following diets for children, one to four years old, have given excellent results in the author's experience.

Let it be emphasized in the beginning that thirst should not be mistaken for hunger. Care should be taken that

the child should receive an adequate amount of water daily.

During the second year, a child may have four meals a day at four-hour intervals, and this schedule may be continued up tc the fourth year.

When weaned, children may be given the pulp and juices of succulent vegetables, such as those of lettuce, cauliflower, cabbage, tomatoes, and of the roots and tubers, —carrots, turnips and beets,—baked or boiled potato (peeled after cooked), cereal and legume purées very thin (these are thicker than cereal gruels), soft eggs, especially the yolk two or three times a week, the ripe juices and soft pulp of fresh fruits such as those of oranges, peaches, pears and plums, the juice of lemons and pineapple, sweetened with milk or malt sugar, the stewed pulp of prunes and apples, and the juices of berries.

Never drain vegetables, cereals or legumes in their preparation.

During the third year, it is not necessary to rub the vegetables, cereals and legumes through a purée sieve. The vegetables can be given chopped fine, the cereals can be given whole, and the legume purées may be thicker. Dates and raisins cut up fine may be added, and peanut butter may be spread on toast (also advised at 18 months).

If milk or cream is added to the menu, always give it sterilized, both for bacteriological and physiological reasons.

During the fourth year, any of the foods recommended in this book may be given, taking into account the digestion of each particular child.

Rules Worth Observing

1. If a child refuses plain bread and butter between meals, give him nothing, for he is not hungry.
2. Give little variety at a time. Generally too great a variety is given.

3. Allow plenty of time for each meal. If a child plays with his food, remove it, and offer him no food until the next meal.
4. Do not force a child to eat. Do not offer him sweets when simple food is refused.
5. Teach him to chew his food thoroughly.
6. Keep the child happy at meal time.
7. Thirst is often mistaken for hunger.
8. Little or no cane sugar is needed if the child receives the required amount of fruit juices, dates, prunes, and raisins, or perhaps honey.
9. Do not give highly seasoned foods from the family dish. Serve the child's meal before the spices are added.
10. Never give fried foods of any kind, hot breads, cakes, canned or preserved fruits. Graham crackers may sometimes satisfy the desire for sweets.

The following is a typical one day's food chart for a child during the second year:—

6 A. M.—⅔ cup oatmeal purée.

10 A. M.—4 tablespoons boiled carrots mashed through a purée sieve. (Vary this with any succulent vegetable given above.) A pinch of salt and butter or olive oil may be added. ½ cup unrefined cornmeal purée. (Vary this with unrefined wheat and oats.)

2 P. M.—Yolk of soft boiled egg every other day. Mashed, boiled or baked potato with a pinch of salt and a little butter or olive oil. When egg is not given, prepare a cup of pea or bean purée and serve with this ½ cup of vegetables instead of the potato.

6 P. M.—Pulp of baked apple, prunes or that of fresh ripe peaches, pears or plums, or the juices of berries. 1 slice of oven dried toast.

There should be no constipation on this diet. If there is a tendency towards diarrhea, some sterilized milk may be given instead of some of the legumes, and no fruit pulp, but fruit juices should be continued. Less vegetables and more potato may also prove beneficial to counteract this tendency.

Children's Diet with Milk.—For those for whom it seems impossible to break away from the time-honored custom of feeding children with cow's milk, the following day's food chart for a twelve months' child is given:—

6 A. M.—12 ounces sterilized whole milk.
½ slice oven dried toast.
8 A. M.—¼ cup orange juice.
10 A. M.—⅔ cup oatmeal purée, and ¼ cup boiled, mashed carrots; or yolk of an egg, and a baked potato; or pea purée and a vegetable.
2. P. M.—12 ounces sterilized, whole milk and ½ slice oven dried toast.
6 P. M.—Cornmeal purée cooked in double boiler in 8 ounces milk; (⅔ cup when cooked) a small amount of sugar and a pinch of salt may be added.
¼ cup fruit juice.

During the fourth year, breakfast may be given at 7 A.M., orange juice at 10:30 A.M., luncheon at 1 P.M., and dinner at 5:30 P.M.

At an early age, the majority of books recommend meats in many forms. In place of these the author recommends peas, beans and lentils, all cereals, especially whole grain wheat and oatmeal, eggs and nut butters, such as peanut butter and soy bean butter. (See Chapter X.) These foods should be combined with any of the vegetables, roots, tubers and fruits. The value of honey is again emphasized. Cocoa may occasionally be given.

If these dietaries for infants and children are carried out with thought, and a genuine desire for the child's wel-

fare, good results and a lack of the common ailments and diseases of childhood are practically inevitable.

Goat's Milk.—Goat's milk has been used especially for infant feeding from early historic times, particularly in Italy, Switzerland, France and Germany. Its use has certain advantages over that of cow's milk, and it is concerning these that J. K. Culvin [17] writes an article that is worthy of consideration, and from which the following points of interest are taken:—

Spargo states that the neglect of the goat as a milk animal, especially for infants, is much to be deplored. Rosenau says that the goat's milk seems to be well fitted for the human infant, and that it is a great pity it is not more generally employed. Goats are practically immune to tuberculosis.

The goat is especially useful to those who desire a small amount of milk, and do not have room or cannot afford to keep a cow, and great benefit is thus derived from having fresh milk at hand at a low cost.

Chemical Composition of Goat's Milk

Water	86.88
Protein	3.76
Fat	4.07
Carbohydrate	4.64
Ash	0.85

From these figures it is clearly seen that the food principles in cow's milk and goat's milk are very similar quantitatively.

Chemically, there is more difference. The casein coagulum is a little more firm than that of cow's milk. The fat closely resembles that in human milk. Goat's milk fat is richer in insoluble acids than cow's milk fat, but on the whole there is very little difference. Regarding the salt content, goat's milk differs from cow's milk in containing tricalcium phosphate, di- and tri-magnesium phosphate, monopotassium

[17] *Arch. Pediat.*, Sept., 1921.

phosphate and no monomagnesium or dipotassium phosphate. There are more chlorides in goat's than in human and cow's milk, and sodium and potassium chlorides are present in the former but not in the latter.

The goat has been called the "poor man's cow" because the expense of keeping a goat is much less, and the goat produces much more milk in proportion to its size. They are hardy animals, and will supply sufficient milk for the average family, and can be kept where it would be impossible to keep a cow. A goat can be kept on a small plot of grass, and fresh, pure milk can be easily procured.

Dr. DeSanctis'[18] conclusion regarding the cause of the benefit derived from the egg yolk is different from that stated by the author as the possible cause throughout the chapter.

This experimental proof of the value of egg yolk in the feeding of nursing infants should shed new light on the modification of cow's milk in certain difficult cases at least, if not in the case of all normal infants.

One teaspoon of soft boiled egg was added daily to the formula. The response was an immediate gain in weight in a three months' old infant which had been receiving whole milk, water and dextri-maltose. The yolk was gradually increased until the whole yolk was added daily. Dr. DeSanctis attributes the 8–12 ounces gained weekly to the addition of the fat-soluble A vitamine. Since the first experiment, he has used the egg yolk in many cases with the same results, even in cases in which orange juice had been used.

[18] "Egg Yolk in Infant Feeding," *Arch. Pediat.*, Feb., 1922.

(This article was published after this book was in press.)

CHAPTER IX

VITAMINES

The subject of vitamines is not more than eleven years old. Vitamines have existed through countless ages, yet man has been entirely ignorant of them, and even at the present time, very little is known of their nature.

However, one very important fact concerning them has been learned, and that is that they are absolutely necessary for a healthy body. For this reason they have been appropriately designated as the "sixth food principle."

A great deal of research work is being devoted to them both in Europe and America. In our own country Dr. L. B. Mendel of Yale University, Dr. T. B. Osborne of the Connecticut Experimental Station, Drs. E. V. McCollum and N. Simmonds of The Johns Hopkins University, Drs. Alfred Hess and L. J. Unger of New York, Drs. H. Steenbock, E. B. Hart, P. W. Boutwell, H. E. Kent of The University of Wisconsin,—Drs. S. S. Zilva, A. Hardin, J. C. Drummond, K. H. Coward, F. G. Hopkins, E. Mellanby, E. M. Hume, H. Chick of England and others of Europe and America have proved interesting facts.

Vitamines are as yet substances very poorly defined. The word was first proposed by Casimir Funk, a Pole. They have also been termed "accessory food substances" by Hopkins of England, a very misleading designation. Much criticism has been expended on the term vitamine. The termination "amine" denotes nitrogen is present, while the first part of the word signifies the necessity of

this substance to life. But, as a matter of fact, the character of these substances is a mystery.

There is a general opinion to-day that certain diseases are caused by deficiencies in the diet, and that these deficiencies are in other words, vitamines. Each "deficiency disease" is said to be produced by the absence of a particular vitamine. In this sense the vitamines must be specific. Xerophthalmia, and beri-beri are said to be the result of the absence of certain vitamines in the food, although Dr. Hess says that even in beri-beri the degenerations are not so sharply defined as in scurvy. Scurvy, although conclusions concerning this disease are very conflicting, rickets, pellagra, anemia, neurasthenia and other diseases are claimed to be the result, in part, of the absence of these substances.

There are three known vitamines,—the fat-soluble A, the water-soluble B, and the water-soluble C. The first is sometimes called the antirachitic vitamine, the second the antineuritic vitamine, and the third the antiscorbutic vitamine.

In general, the foods that are lacking in these vitamines are refined cereals, salted and dried meats, canned foods, dried foods, foods subjected to long periods of cooking and a few to short periods of cooking. "Storage organs," such as cereals and white potatoes, are low in vitamine A. Leafy foods, such as lettuce, cabbage and cauliflower, are valuable for vitamine A. Alkalies have a tendency to destroy at least the antiscorbutic vitamine. For this reason soda should not be added to the water in which vegetables, navy beans, etc., are cooked. Foods which are acid, such as oranges and tomatoes, retain their potency when raised to high temperatures, or dried.

It is said that a certain amount of vitamines can take care of only a limited amount of carbohydrate. This fact in the author's opinion may account for many acute and chronic diseases, especially among people who are given

to eating excessive quantities of cane sugar lacking in mineral matter.

Prominent among the detailed facts, so far as research men have been able to ascertain, certain points of interest, concerning the three vitamines, are given as follows:—

The antirachitic or fat-soluble A vitamine is abundant in butter fat, egg yolk, cod-liver oil, and, to a little less degree, in beef fat, and the glandular organs of animals. It is found in small quantities, in comparison to these foods, in the fats and oils of the vegetable kingdom, in fruits, cereals, legumes, nuts, lettuce, cabbage, carrots, potatoes, etc. It is more abundant in foods in which yellow coloring matter is present. H. Steenbock,[1] P. W. Boutwell and others have found considerable quantities in carrots and sweet potatoes, and these may be classed, in respect to the fat-soluble vitamine, with the leafy foods, spinach, celery, lettuce, cabbage, beet greens, etc. Yellow maize for the same reason is high in this vitamine, while white maize is low. Cereals, white potatoes, parsnips and beets have a small proportion in comparison to these foods rich in yellow and green coloring matter. This vitamine is not very resistant to heat, for it is destroyed by aëration at 100° C., the length of time varying with the different foods. Drying is not as fatal to it as to water-soluble C. Its absence has many times been charged as the cause of rickets, or as a contributing cause of this disease, but the most recent investigations seem to prove that the lack of fat-soluble A is not the only cause.

Dr. Alfred Hess [2] has made numerous experiments, and concludes that sunlight has a dominant influence on the etiology of rickets, and that it not only brings about a clinical cure of the characteristic lesions, but also brings about an increase in the inorganic phosphorus of the blood. Drs. Hopkins and Mellanby of England, and Funk have

[1] *J. Biol. Chem.*, Jan., 1920.
[2] *J. A. M. A.*, Jan., 1922.

claimed it was caused by the absence of the fat-soluble A vitamine, while Dr. Hess claims that an abundance of vitamine A does not prevent rickets. He maintains that an all around complete diet is a determining factor in this disease.

Howland and Kramer claim a low content of inorganic phosphorus in the blood of a child is nearly conclusive evidence of rickets.

Eric Pritchard of England has said rickets may be due to an acidosis, in which case the mineral matter may be withdrawn from the bones for the purpose of neutralization. Children frequently well fed develop it.

McCollum, Osborne and Mendel have claimed that this vitamine is necessary for growth, and that its absence gives rise to xerophthalmia.

Sidney Walker,[3] however, claims that the lack of fat-soluble A produces xerophthalmia in a variable percentage of experimental animals, and that there is obviously another factor or factors causing this disease not yet worked out.

McCollum and Simmonds [4] have published the following recent conclusions regarding the etiology of rickets:—

Mellanby has reported the production of rickets in puppies by diets deficient in their content of fat-soluble A. Unfortunately it has not been possible to evaluate Mellanby's results by reading his published writings since he has never supplied objective proof of the production of rickets in the form of illustrations showing the appearance of his specimens through the microscope. This omission has been unfortunate in as much as the diagnosis of this disease can be made with certainty only on the evidence derived from microscopic changes in the bones. The gross deformities which characterize rickets can be simulated in other pathological conditions. Evidence afforded by the X-ray is not convincing.

[3] *J. A. M. A.*, Jan., 1922.
[4] Bull. Johns Hopkins Hosp., May, 1921.

Through experiments these investigators conclude:—

Diets which were low in their content of fat-soluble A and phosphorus produced, in the majority of the young rats placed upon them, pathological conditions of the skeleton having a fundamental resemblance to rickets. The pathological conditions produced were not identical, however, with that disease as it usually manifests itself in the human being.

When the deficiency in the phosphorus was compensated for by the addition of a complete salt mixture containing the phosphorus ion, the deficiency in fat-soluble A still existing, no pathological changes of rachitic nature developed. The addition of the phosphorus ion to the diets deficient in it and in the organic factor, prevented therefore, the development of any changes of a rickets-like nature.

The phosphorus ion in the diet may be a determining influence for or against the development of rickets.

If the phosphorus content of the diet is sufficiently high, a deficiency of fat-soluble A cannot cause rickets-like changes in the skeleton. A deficiency in fat-soluble A cannot be the sole cause of rickets. Conversely, it is necessary that the diet be low in its content of phosphorus, all other factors, except fat-soluble A, being optimal for rickets-like conditions to develop.

Since the addition of the phosphorus ion to the diet prevented the development of the rickets-like changes in the skeleton, but had no effect in preventing xerophthalmia, it seems permissible to infer that xerophthalmia and rickets do not have an identical etiology.

The above results do not in our opinion exclude the fat-soluble A from consideration as an etiological factor in the production of rickets and kindred diseases, since the level of the blood phosphorus is, in all probability, determined in part by the amount of the fat-soluble A available for the needs of the organism.

P. G. Shipley, E. A. Park, E. V. McCollum, N. Simmonds, and H. T. Parsons [5] have found that cod-liver oil

[5] *J. Biol. Chem.*, Jan., 1921.

causes calcium salts to be deposited in the cartilage and bones in rats and that therefore, its administration is beneficial in rickets.

E. A. Park and J. Howland [6] claim cod-liver oil is a specific for rickets.

This disease is very common, and is characterized by impaired nutrition, extreme sensitiveness, fever and soft muscles and bones.

The antineuritic or water-soluble B vitamine was discovered about the same time by a different group of investigators. Funk proved that butter fat has no power to cure polyneuritis in birds or beri-beri in man, and later McCollum solved the question, and designated these two substances as A and B. B is abundant in unrefined cereals and yeast and present in smaller amounts in legumes, eggs, milk, fruits, vegetables, roots, tubers, nuts and glandular organs. It is the most abundantly distributed in nature and is the most resistant to heat as it resists autoclaving for an hour.

Beri-beri which is caused by the absence of this vitamine, in part, if not entirely, is characterized by numbness, cramps, catarrh, edema, pain and swelling in the limbs, and finally paralysis.

The third vitamine that has created much interest is the antiscorbutic or water-soluble C vitamine. But according to McCollum and his coworkers there is doubt as to the relation of this vitamine to scurvy, as they claim there is no protective substance against this disease, and that it is not a deficiency disease in the same sense of xerophthalmia and beri-beri. Other authorities claim the lack of this vitamine is the cause of scurvy. Dr. Funk was the first to pronounce this fact. Vitamine C is the most abundant in fresh fruits, vegetables, roots and tubers, especially oranges, lemons, tomatoes, cabbage, potatoes and turnips. Milk is low in this vitamine. It is also found

[6] Bull. Johns Hopkins Hosp., Nov., 1921.

in germinated cereals and legumes, according to Chick and Hume.

Heat seems to affect water-soluble C vitamine differently in different foods. For instance, heat apparently destroys it in milk, but not in orange juice, tomatoes, or potatoes, that is if they are not subjected to long periods of cooking. Generally speaking, this vitamine is the most susceptible to heat.

Some investigators claim aging destroys water-soluble C vitamine more than heat. However, it is difficult to reconcile this conclusion to the fact that scurvy has been known to develop in breast-fed infants. In this case the mother's milk may be at fault, and this vitamine present in an insufficient amount. Drummond, Coward and Watson [7] say it was originally shown by McCollum, Simmonds and Pitz (1916) and confirmed by Drummond (1918) that the milk secreted by the lactating female will tend to be deficient in vitamines unless her diet contains adequate amounts of these substances. More recently a great deal of experimental evidence has been obtained in support of these observations, and from our own observations we are inclined to believe that this cause is by far the most important in causing such variations.

Dr. Hess claims that aging causes the destruction of this vitamine through oxidation. This theory has been confirmed by Zilva at the Lister Institute of Medical Research in London. The facts at present available point to the sensitiveness of both the fat-soluble A and the water-soluble C vitamine toward oxidative influences, whereas the water-soluble B vitamine seems far more stable towards heat and oxidation.

Dr. Hess has had unusual opportunities to observe the results of milk modifications in New York, and has made a special study of scurvy. He says cases of scurvy have developed upon almost every diet given to children,—on

[7] *Biochem. J.*, Vol. XV, No. 4, 1921.

pasteurized milk, milk rich or poor in fat, buttermilk, albumin milk, raw milk and mother's milk. It is probable that all these milks had lost their antiscorbutic power through aging, mother's milk excepted, or that they were poor in mineral substances, or lacking in vitamine C.

His classification of scurvy is as follows:—

In the latent stage there is stationary weight, pallor, and anorexia, edema, exaggerated knee jerks and cardiorespiratory syndrome.

In the sub-acute stage the above symptoms are more marked, and there is enlargement of the heart, irritability, redness of gums, tenderness of extremities, and perhaps blood and albumin in the urine.

In the florid stage there are hemorrhagic disturbances.

It is a well-known fact that the first two stages are often unrecognized.

W. Pitz [8] claims lack of calcium may be a contributing cause of scurvy. An "incomplete protein," and the character of the flora of the digestive tract may also play a part in its development. Pitz has suggested that calcium salts may control the permeability of various animal tissues and thereby afford protection against invading agents. The various functions of calcium are again emphasized.

Shipley, McCollum and Simmonds [9] have found that rats fed a diet complete, except for the absence of vitamine B, developed lesions in the bones essentially identical with those seen in guinea pigs suffering from acute and uncomplicated scurvy. Rats confined to the same diet supplemented with B do not show these changes. The bones of rats on a diet which is only deficient in A are osteoporotic, but have no other resemblance to the bones of scorbutic animals. These results appear very puzzling, and some future explanation is hoped for from these investigators.

[8] *J. Biol. Chem.*, Nov., 1918.
[9] *J. Biol. Chem.*, Dec., 1921.

Orange juice is heralded as the prototype of antiscorbutics,—it invariably helps and generally cures this disease.

Dr. Hess has spent considerable time in trying to find a substitute for orange juice as this is expensive for many families. He tried yeast and found it did not produce good results. Potato water with some of the pulp, and tomato juice, however, proved most beneficial. (Allow twice the amount of these of orange juice, following the schedule in Chapter VIII.) The juices of oranges and tomatoes may be given in a nursing bottle when they amount to four or six ounces, according to the age of the child. Canned tomatoes may be substituted for fresh tomatoes, if necessary, and given when orange juice is not tolerated or available.

Pellagra has been said to be another deficiency disease, although the exact cause is very doubtful along with rickets and possibly scurvy, and beri-beri. It has been claimed that the true cause was worked out at the University of Rome by Professors Alessandrini and Scala whose conclusions were that it is a chronic acid intoxication, and not an infection, and is caused by drinking soft water coming from a clay soil, and prevented by drinking water rich in calcium and magnesium carbonates.

The author does not deny these facts, but if the lack of carbonates is the cause, why should not foods lacking in these minerals be a cause also,—why should the cause be limited to soft drinking water? Foods lacking in these minerals, through kind or preparation, would seem to be the more probable cause. These investigators claim pellagra is cured by the hypodermic injection of a 10 per cent solution of sodium citrate, in doses of 1 c.c. daily for 15–30 days, according to the severity of the case, then on alternate days for as long a time. Why should hypodermic injections of an alkali be necessary when many foods are

rich in these minerals, and would supply them with none of the risks of hypodermic injections?

Pellagra has been known frequently to develop among well-to-do classes as well as among the poorer classes. From this fact the cause seems to point to an auto-intoxication caused by a diet lacking in mineral substances, and possibly "complete protein" and vitamines A and B. Those interested in the subject know that pellagra can be cured by a scientific diet.

McCollum, Simmonds and Parsons [10] hold the view that pellagra may be caused by the lack of mineral substances in the diet, especially calcium, and the lack of fat-soluble A and a deficient protein. H. C. Sherman, J. C. Winters, V. Phillips and E. V. McCollum think an infective agent is involved in pellagra, induced by faulty nutrition. This conclusion again substantiates the author's conviction concerning the lack of antibodies, produced in part by an inadequate mineral supply, as a contributing etiological factor in some so-called deficiency diseases. Where pellagra is common large amounts of refined wheat, rice and corn, and much sugar, molasses and meat, especially pork, are used. The diet is lacking, for the most part, in milk, eggs, leafy vegetables and fruits. Leafy vegetables, fruits and milk are rich in calcium, and vitamine A, and eggs have a smaller amount of calcium and a larger amount of vitamine A. Leafy vegetables and fruits supplement the cereals, legumes, roots and tubers in mineral substances, protein and vitamine A, according to McCollum and his coworkers. They also supplement meats in mineral substances and vitamines.

Pellagra is characterized by weakness, indigestion, nervous affections and eruptions.

Conclusion.—These many facts concerning vitamines should require much consideration in all manipulations to

[10] *J. Biol. Chem.*, May, 1919.

which foods possessing these necessary substances are subjected, and again special emphasis should be laid on the value of fresh, raw fruits and vegetables, and short periods of cooking.

Vitamine D.—Casimir Funk and Harry E. Dubin[11] have separated from vitamine B a substance which they call, provisionally, vitamine D, and which acts on microorganisms. Vitamine D appears to be a definite and specific substance stimulating the growth of yeast.

It may develop that the vitamine D and the vitamine-like substance obtained from proteins such as casein, may have some special function in the body, and such experiments are now being planned.

Dental Caries and Pyorrhea.— Percy R. Howe,[12] assistant Professor of Dental Research, Harvard University, gives the following results of some of his researches which appear to be of special interest in connection with the study of the effects of the lack of mineral matter and vitamines in the diet, and the possible cause of many infections as suggested by the author:

If the profession of dentistry is to undertake to prevent dental diseases it will have to apply other measures than are at present employed. We clean the teeth to prevent decay. A few hours and the process must be repeated. The cleansing must be kept up continuously . . . on the other hand, native races do not clean their teeth, do not need to and yet do not have dental caries. And so it is with the cavities in the teeth. They are filled. The fillings are on an average good for, say, 5 years. Disintegration of the teeth recurs. The teeth are again filled, and the filling lasts for a few more years. Then the process is repeated. We have not in either case removed the cause of the caries.

Our preventive measures are based on the theory of Miller, who held that caries is due to the fermentation of carbohydrate with the formation of lactic acid.

[11] *J. Biol. Chem.*, Oct., 1921.
[12] *The Dental Cosmos,* Nov., 1921.

Now, while Miller was able to affect some extracted teeth in a test tube by fermenting bread with saliva, he was unable to produce any effect upon the teeth of living animals. He thinks that it is the structure of the teeth that prevents the decay. He continuously speaks of tooth structure as a most decided factor in caries. But be this as it may, the fact remains that when Miller's theory is applied to living animals, it produces no effect upon the teeth. I have elsewhere stated that after feeding 30 guinea pigs for a year upon various sugars and starches and microörganisms, no effect upon their teeth was discernible. The teeth of the guinea pig are very easily decalcified in a test tube, decalcification being only a matter of an hour or so, while the human tooth requires a number of days. It is evident then that the structure of the teeth of these animals is very favorable for the fermentation process to affect it, yet in the living state acids from fermentation have no effect.

It is now possible entirely to decalcify the teeth of guinea pigs by an alteration in their diet which may be compared to the difference between natural foods and refined foods. . . . In some instances distinct cavities have formed. Ground sections show that the dentin is badly disintegrated. The destructive effects are rapid and severe. This seems to be very similar to true dental caries.

Secondly, the alveolar process is absorbed, the teeth become very loose and protrude from their sockets, and the articulation is disarranged. Inflammatory and degenerative changes occur in the peridental tissues. Indeed the condition closely resembles pyorrhea. Elsewhere we have shown that the injection of microörganisms into the gums produces no condition that simulates pyorrhea. The infection then is not the causative factor but is secondary. . . .

Irregularities of the teeth occur—carious areas are found in the jaws . . . considerable areas of the jaws become decalcified. Upon a return to normal diet large plaques of new bone form.

It is a common theory to associate tooth difficulties with eye troubles. Running eyes occur with regularity in scorbutic feeding . . . many of our specimens of guinea pigs'

skulls show decalcified areas of the bone in the orbit, usually at the base of the teeth.

In young mothers, whose diets are deficient in respect to vitamines . . . some have cloudy spots upon the coatings of the eye. With normal feeding these disappear. One animal was born with no eyes. . . . In another, opacity of the lens of both eyes had gradually occurred. . . . After feeding her large quantities of orange juice it entirely cleared up. . . . When we consider how common dental caries is, and how many youngsters have eyes that need correction we may, in the light of these experiments, reason that a faulty nutritional diet lies behind both.

Joint infection regularly follows deficiency in the antiscorbutic vitamine . . . looseness of the teeth occurs at the same time. . . . Both are indicative of the same general disturbance.

Zilva [13] states that the pulps of the teeth are one of the first things affected in antiscorbutic deficiency, and that the teeth are profoundly affected. He believes a great deal of latent scurvy exists and that caries may be a result of it.

In calcium disturbances of this kind, two things are to be considered,—first, a sufficient supply of calcium, second, the necessary elements for inducing the fixation of the calcium. The fixation seems to be governed by the vitamine content of the food.

Dr. Howe's researches and conclusions are extremely interesting not only in relation to the diseases of the jaws and teeth, but also in relation to the influence of calcium and vitamines in many diseases of the body.

The author has been convinced of the supplementary relationship of mineral matter and vitamines in the several years of lecture work, and the lack of this in a high protein diet. Elsewhere in this little volume this has been said to be the cause of many organic diseases, and suggested as the possible cause of some infectious diseases.

In this chapter these research men seem to prove that

[13] Proceedings of Royal Society of London Series B., Vol. 90, 1919.

lack of vitamines and mineral substances are primarily responsible for deficiency diseases, and are the primary cause of some infections, the bacteria themselves being the secondary cause.

Pyorrhea is a disease which has probably received more attention than any other branch of dentistry, and its problem is only partly solved.

CHAPTER X

A FEW HEALTHFUL RECIPES; SOME INVALID RECIPES MISCELLANEOUS SUBJECTS

Chestnut Purée (for those desiring cream).—Boil one pound of chestnuts a few minutes, drain and remove skins. Boil again until tender. Drain and press them through a nut-butter grinder. Sweeten, flavor with vanilla and moisten with a little cream. Put the purée in a sauce-pan and stir over a slow heat until dry. Then press the purée through a colander or potato press onto the dish in which it is to be served. Form it into a circle, taking care not to destroy its lightness and form. Serve with whipped cream in the center of the ring.

Chestnuts are the best balanced of the nuts. Their chemical composition is as follows:—

	Chestnuts	Other Nuts
Protein	6.6 per cent.	15.–25.
Fat	8.0 " "	50.–70.
Carbohydrate	45.0 " "	10.00
Mineral Matter	1.7 " "	2.00
Cellulose	.7 " "	1.–5.
Water	38.0 " "	4.–5.

A much greater amount of carbohydrate is required for health than protein and fat, and the above figures clearly demonstrate the excellent proportion of food principles in chestnuts.

The peasantry of France and Italy often eat two meals a day of chestnuts.

Baked Lentils (Meat Substitute)

2 cups lentils	½ cup bread crumbs
¼ cup onions	2 cups tomatoes
¼ cup butter	½ cup cream (if preferred)
1½ tablespoon salt	Pinch of soda
1 tablespoonful celery salt	

Wash the lentils and soak in cold water several hours. (Do not drain.) Add the onions and boil one hour or until tender. Add salt and celery salt when they are half done. Press tomatoes through a fine sieve, add the soda and cream, and heat to the boiling point. Add this to the lentils which should be boiled sufficiently dry so that draining is not necessary. Place them in a buttered baking dish, cover with buttered bread crumbs, and bake in the oven until the crumbs are a golden brown.

Lentils are not as popular as peas and beans, yet they are an even more valuable food. They are richer in protein and have a much higher mineral content. The largest supply comes from Egypt.

Lentil Toast.—This is made from lentils prepared as in the above recipe before they are baked, adding sufficient cream and tomato juice to allow them to be poured onto buttered toast. This makes a pleasant variation from milk toast or egg on toast for invalids.

Soy Bean Croquettes (cream may be omitted).—Soak ½ pound soy beans over night. In the morning do not drain; boil them several hours, until moderately tender. (They will not be as tender as navy beans unless cooked under pressure.) Add salt when half done. There should be ½ cup of liquid when the boiling is completed.

To this ½ cup bean stock, add ½ cup cream and two level tablespoons cornstarch, and stir until dissolved. Put this on to boil and add thyme and bay leaf to flavor. To 1½ cups tomato juice, add a pinch of soda and heat. Add the tomato juice gradually to the bean stock and cream and season with salt and pepper to taste.

Pass the drained boiled beans through a meat grinder, and add to them two small onions cut fine, one egg yolk, and salt and pepper to taste. To this mixture, add the cooked oatmeal which is used as a binding agent (1/4 the quantity of the soy beans). (Recipe for oatmeal toast used.)

Mix thoroughly, and form into croquettes. Heat them in the sauce already prepared, and serve garnished with water cress.

Oatmeal Toast.—To 1 1/2 cups boiling, salted water, add 1 cup oatmeal, stirring constantly until thick and stiff, which will require but a few minutes' boiling. (This is used as a binding agent in the above recipe.)

To serve as oatmeal toast, turn it into a bread pan. When cold, cut in thin slices, and fry in Crisco or Snow-drift.

Soy Bean Cookery.—For those who are interested in soy bean cookery and its beneficial results, there are many recipes for gruels, muffins, breads and cakes. However, almost any recipe for these can be used substituting one-half of the wheat flour called for with soy bean flour.

The bean is so rich in fat that in China and Japan a variety of cheese is made from it. In England a new vegetable milk has been produced from it in the following manner:—The beans are soaked for a few hours, and finely ground in a meat grinder. They are then boiled in about three times their volume of water for a half hour. The liquid is then drained, and it has an appearance of a milky emulsion very similar to cow's milk. This vegetable milk can be used in breads, cakes, custards, etc. It has a slightly acid reaction, it curdles through the action of rennet, and upon standing, it develops lactic acid. This is often of great value in certain cases of diarrhea and malnutrition.

A product similar to peanut-butter can be made from the soy bean. This is especially recommended by the

author as an excellent food for children for spreading on bread and toast. It is easily prepared by passing the dry beans through a meat grinder, and then through the nut-butter grinder. (The latter is difficult to use the first time.) Place the ground beans in a shallow pan in the oven and parch, stirring frequently. Mix with them salt and enough olive oil or other vegetable oil to make a paste.

Chemical Composition of the Soy Bean (Average)

Water	10.00 per cent.
Protein	37.13 " "
Fat	18.38 " "
Carbohydrate	24.40 " "
Lecithin	1.60 " "
Mineral Matter	4.30 " "
Cellulose	4.47 " "

Almond Milk.—This is another vegetable milk that is creating considerable interest. It is recommended for adults in cases of typhoid fever, intestinal putrefaction, nephritis, anemia, malnutrition, fermentation, for infants with whom cow's milk or mother's milk does not agree, and in cases of rickets. It ferments much less readily than cow's milk, and its protein is less subject to putrefaction in the intestines. It has a higher fat content than cow's milk and a lower sugar content, and contains a large amount of phosphorus, and a smaller amount of sodium chloride.

To prepare the milk, the nuts are finely ground, covered with water, and allowed to stand in the refrigerator over night. They are then pressed through a potato ricer and strained through gauze. One hundred grams of nuts may be covered with 200 grams of water, and when strained this is diluted up to 300 c.c. water. This milk must be kept cold to prevent fermentation.

The chemical composition of this milk compared with that of cow's milk is as follows:—

	Almond Milk	Cow's Milk
Protein	4.4 per cent.	3.0 per cent.
Fat	7.0 " "	4.0 " "
Carbohydrate	1.2 " "	5.0 " "
Mineral Matter ...	.55 " "	.7 " "
Water	86.0 " "	87.0 " "

Nut, Date and Bran Muffins (for Diabetes)

3 cups bran
4 eggs
3 teaspoons butter
1½ cups sour cream or buttermilk
¾ teaspoons soda
¾ " salt
½ cup English walnuts
½ cup dates

Cream the butter, and add the beaten yolks. Add the cream, soda, salt, walnuts, dates and bran. Lastly add the beaten whites. Bake in a moderate oven 30 minutes if muffins are large.

Nest Eggs.—This may be called a complete food, and no other kind need necessarily be served with it as the egg furnishes the protein, fat, vitamines, and a liberal amount of mineral matter, while the potato supplies a generous amount of mineral matter, carbohydrate and vitamines, and also a small amount of a so-called "complete protein."

Wash and bake one large potato. Cut in half, scoop out the inside and mash. To ½ cup mashed potato, add ½ tablespoon butter, 1 tablespoon cream and a pinch of salt. Line the potato shell with this mixture, place the yolk or whole egg, if the potato shell is large enough, in the cavity, sprinkle with salt and buttered crumbs, and bake until the potato mixture is slightly browned.

Rice may be used in the same way, as natural brown rice is a substitute for potato in many respects, if the potato is eaten with the skin.

Rice versus the Potato.—Every one probably has heard much about rice as a potato substitute. Standard head rice such as is generally purchased is not a substitute for

the potato. This rice, lacking in salts, protein and vitamines must not be confounded with the potato which is rich in salts and vitamines, especially if it is eaten with the skin, according to McCollum,[1] and which has an almost "complete protein." Hindhede of Copenhagen and others have published valuable information on potato protein. Natural brown rice, however, is a good substitute for the potato, although it cannot claim all the qualities possessed by its rival. (See Scurvy, Chapter IX; Protein, Chapter I.)

The potato contains six times as much calcium, twenty times as much phosphorus and five times as much iron as standard head rice. It costs considerable money to mill this refined rice, while it costs only about one-sixth as much to mill natural brown rice. The average consumer prefers the snow-white appearance of the denatured, refined product to the health-producing substances of the natural product, which includes mineral substances, vitamines A and B, and a small amount of protein.

The commercially known "Unpolished Rice" is very misleading. One would be led to believe that the outer bran had not been removed. However, it has partly been removed, and the rice is then treated with glucose and talcum, although not to the extent that these substances are applied to the ordinary commercial rice. Natural brown rice can be purchased at certain pure food stores.

While the potato is an excellent food, it is not an ideal food, as it is too low in calcium, sodium and chlorine and vitamine A for the promotion of nutrition at the optimum rate. McCollum compares the properties of the potato to the cereals, and says it remains for future investigators to show whether or not the coagulated protein of the potato has a higher biological value than those of the cereals. Like the seeds, "it consists largely of reserve food materials and relatively little of cellular elements."

[1] "The Newer Knowledge of Nutrition."

Therefore, its mineral and vitamine content should be supplemented by leafy foods.

Souffled Eggs.—Beat the white of an egg until stiff and season with a pinch of salt. Butter a tumbler or cup, pour the white into it, and place the cup in a pan of warm water, allowing the water to heat gradually until the boiling point is reached. As the white rises, make a depression and drop in the yolk, allowing it to remain until thoroughly hot.

Steamed Eggs.—Butter small molds, and sprinkle with finely chopped parsley. Carefully slip an egg into the mold, and sprinkle with salt. Place the mold in a pan of boiling water to ¾ its depth, and allow the egg to cook until the white is firm, keeping the water below the boiling-point. Remove from the mold, and serve with tomato sauce.

Egg Timbales.—Beat 1 egg slightly, add 1 tablespoon of cream, a few drops of onion juice if desired, and a pinch of salt and celery salt. Turn the mixture into a small buttered mold. Set it in a pan of hot water, until firm. Remove the mixture from the mold, and serve with cream or tomato sauce

Oatmeal Cookies.—These are especially recommended for children in place of sweets. The ingredients, before baked, will be found difficult to bind together,—a little pressure, however, after they are dropped onto the baking sheet will overcome this difficulty.

1½	cups rolled oats	1	tablespoon vanilla
½	cup sugar (brown)	1	" melted butter
2	eggs	½	teaspoon salt

Mix ingredients thoroughly, drop from a spoon onto a baking sheet, and bake about five minutes or until a golden brown.

Gruels for Infants and Invalids.—Gruels can be made either from the grain or from the flour of any cereal or

legume. If the flour is used, it should first be mixed with a little cold water, then added to the boiling water. If made with milk, they should be cooked in a double boiler. For young infants they should be strained through a fine purée sieve before being served.

Mix 1 tablespoon unrefined cereal flour with a little cold water, and add, gradually, to a pint of boiling water (or milk, if preferred). Add 2 level teaspoons milk or malt sugar, a pinch of salt, and boil the mixture for ten minutes very gently. If too much water boils away, add sufficient water to make a cup of gruel when it is served. Legume and cereal gruels may be served very thick if desired by doubling or tripling the amount of cereal flour or legumes. (Recommended in certain difficult cases.)[2]

Legume Purées.—Legume purées for children and invalids are made by boiling the legumes in salted water until tender, then rubbing them through a purée sieve. A binding agent is sometimes desirable, and this is furnished through mixing a small amount of wheat flour with a little cold water, or with butter and adding it to the purée. These also can be served thick or thin, and different herbs added for flavoring, or a few drops of onion juice or tomato juice. (The odor and flavor of the onion is due to allyl sulphide which is claimed to stimulate the flow of gastric juice, and to act as a mild laxative.)

Albumin Water for Infants and Invalids.—Beat the white of an egg until light, and strain through muslin. Add four ounces of water and a pinch of salt. A teaspoon of malt or milk sugar may be added in fever cases, and also a small amount of orange or lemon juice.

Drinks for Children and Invalids.—These are especially recommended in fevers:—

Jelly and Ice.—With an ice scraper, chip ½ cup ice very fine. Mix with it the same quantity of any kind of jelly.

[2] H. R. Mixsell, *Arch. Pediat.*, Aug., 1920.

Grape or Current Water

6 tablespoons jelly
½ cup boiling water
½ cup cold water
Lemon juice

Dissolve the jelly in the boiling water, add the cold water and lemon juice. Serve ice cold.

Apple Water

1 apple
1 cup boiling water
Lemon juice
Sugar

Cut the apple with the skins into small pieces. Add the boiling water, sugar and lemon juice to taste, strain and serve ice cold.

Egg Lemonade

1 egg
2 tablespoons sugar
3 tablespoons lemon juice
1 cup cold water

Beat the egg, and add the sugar, lemon juice and water. Serve ice cold.

Strawberry Whip

1 cup fresh strawberries
Whites of 2 eggs
¼ cup powdered sugar

Mash the berries, beat the whites until stiff and add the berries and sugar.

Albuminized Orange or Grape Juice

White of 1 egg beaten stiff
Juice of 1 orange or grape juice
Sugar to taste

Serve ice cold.

Grape Juice and Egg

1 egg
1 tablespoon sugar
3 tablespoons grape juice

Beat yolk and white separately. Add the grape juice and sugar to the yolk and fold in the beaten white. Serve ice cold.

Coconut.—The coconut has a lower percentage of protein and fat and a higher percentage of carbohydrate than the other nuts (chestnuts excepted). For this reason it is a better balanced food, and an excellent food when thoroughly masticated. A great deal of the so-called indigestion resulting from nuts is produced because they are not properly masticated, and because they are eaten in conjunction with many other foods. They should be the main dish at whatever meal they are served.

Carl O. Johns, A. F. Finks and Mabel S. Paul [3] have shown that the globulin of the coconut produces normal growth in rats when used as the sole source of protein in an otherwise complete diet. Commercial coconut press cake furnishes the necessary protein for growth at almost a normal rate.

Coconut press cake contains sufficient water-soluble vitamine and experiments indicate that it also contains some fat-soluble vitamine.

Yeast Cure.—If quantities of popular advertising and a common topic of conversation possess any virtue at all, the "yeast cure," both for internal and external use, must be awarded the highest reputation. The majority of people admit a certain degree of ill health of some nature and all are grasping for the much-heralded panacea. They seem to feel if they can take a kind of medicine which at the same time is considered a food, miracles will result. But

[3] *J. Biol. Chem.*, April, 1919.

if certain healthful foods are suggested to these people as a cure, lacking in the medicine attribute, generally they have not the slightest interest unless these foods are those for which they have a particular liking.

The chemical composition of yeast [4] is given by Zellner as follows:

		Per cent.
Nitrogenous Substances 48.4 per cent.	Insoluble Albumin	.12
	Nucleins and Peptones	45.2
	Albumoses	1.6
	Ammonia Compounds	1.48
Ternary Substances 11.8 per cent.	Fatty Bodies	
	Olein	
	Glucose	
	Invertine	
	Glycogen	
	Cholesterin	
	Succinic Acid	
Mineral Substances 13.8 per cent.	Phosphoric Acid	51.1
	Potassium	38.6
	Magnesium	4.1
	Calcium	1.9
	Sulphates of Soda and Silica	4.0

The high protein content of yeast resembles casein, and much of the nitrogen is non-protein represented by such substances as nucleic acid and its derivatives. Yeast is very rich in mineral matter. There is one other substance which it contains, in large quantities,—the water-soluble B vitamine.

It is admitted that certain cures have been wrought through the feeding of yeast. It has been known to cure disease among encamped armies. But its use for human consumption has been suggested only recently, for the most part, since the great war. During the war in Germany, owing to the scarcity of meat, 50–75 grams were commonly consumed daily.

[4] *Zeits. f. Hygiene*, XLIL, p. 3.

But yeast contains certain substances that speak against it. These are the purines, and in these its content is very high. For this reason yeast produces much uric acid in the body.

Yeast should never be allowed in gastric dilatation associated with motor insufficiency as in these cases it remains in the stomach too long. At times yeast produces diarrhea, vomiting and intestinal irritation.

Cow's milk is low in vitamine B, the amount present being dependent upon the vitamine content of the food of the cow. For this reason yeast has been recommended for infant feeding in connection with cow's milk. These experiments proved that yeast produces diarrhea, followed by losses in weight, and that it should not be used as a means of increasing the antineuritic content of infants' foods for the cure of boils or to influence the rate of growth.[5]

Diarrhea is only an exaggerated effect of one of its much prized virtues, for it is claimed that yeast produces lactic and succinic acids in the colon, and that therefore it antagonizes putrefactive bacteria. As was clearly explained in the chapter on reforming the intestinal flora, lactic acid stimulates peristalsis and prevents putrefaction. If peristalsis is exaggerated, naturally diarrhea results.

For this reason yeast has been much advocated in diseases of auto-intoxication.

There are two kinds of yeast, brewer's yeast and grape yeast,—both are used, but the best results seem to follow from the use of the grape yeast, and in this connection this yeast is often obtained by taking the so-called "grape cure," when four or five pounds of grapes are eaten daily.

Jacquemin claims that the failure of brewer's yeast is due to the fact that it is not always pure, and that the yeast is not always collected at the time of its greatest

[5] A. L. Daniels, *Am. J. Dis. Child.*, Jan., 1922.

activity. Brewer's yeast is a ferment which develops in an almost neutral culture medium, and at a generally low temperature. On reaching the stomach it encounters an acid medium, a high temperature and unfavorable surroundings. So it is prevented from producing any beneficial effect. He therefore advocates the grape yeast which is accustomed to high temperatures.

The conclusion concerning the yeast cures is that the effect is only transient. This is the natural supposition, unless the cure were continued indefinitely through life.

In other words, health is dependent upon a certain amount of protein, mineral matter and vitamines daily (fat, carbohydrate and cellulose not entering into this particular discussion) and the production of lactic acid in the intestines. There are innumerable foods that contain the above three food elements, and that produce lactic acid for the prevention of putrefaction,—raw fruits, vegetables, cereals, legumes, roots and tubers. There is every reason in favor of eating these valuable foods daily, and of not consuming quantities of yeast in a great effort to obtain something vital that can be procured in wholesome foods of many kinds. There is no question of securing favorable results from these foods,—it is a guaranteed fact and never a problematic one as in the case of brewer's or grape yeast.

Physiological Action of Olive Oil (E. J. Asnis):—

1. Olive oil inhibits the flow of hydrochloric acid.

2. It exercises a protective action from irritating foods in inflamed and ulcerated areas.

3. It is an antispasmodic affecting the musculature of the pylorus, thus causing relaxation of the pylorus.

4. It hastens passage of foods other than protein from the stomach.

5. It is resistant to the action of fermentation in the stomach.

6. It combats constipation on a normal diet.

7. It overcomes dysentery and diarrhea on a liquid diet.

8. It increases the flow of watery bile, and therefore aids in the passage of gall-stones.

9. One tablespoon is equal to a glass of milk in calories.

Cohnheim's conclusions are as follows (Friedenwald, Ruhräh) :—

1. Cases of dilatation of the stomach due to spasm, caused by an ulcer or fissure at the pylorus are cured, or markedly relieved by the use of large quantities of oil (100–150 grams).

2. Cases of stenosis of the pylorus due to organic disease with secondary dilatation are also usually relatively cured by the use of large quantities of oil; that is, in these cases the oil acts mechanically by relieving friction.

3. Cases of relative stenosis of the pylorus and duodenum which are clinically marked by a continuous hypersecretion and pylorospasm several hours after meals, are much improved or cured by the oil treatment.

4. The pylorospasm found in cases of carcinoma of the pylorus is much diminished or relieved by the oil treatment.

5. Cases of ulcer of the pylorus associated with or without hyperchlorhydria are quickly cured by means of the oil treatment, or by an emulsion of sweet almonds. (See Almond Milk, page 153.)

6. The oil is best taken three times daily, half to one hour before meals; as a rule it is best to administer a wineglassful early in the morning and two dessertspoonfuls before dinner and supper. In mild cases an emulsion of sweet almonds may be substituted for it.

7. The oil fulfills three indications: it overcomes pylorospasm; it relieves friction and tends to improve the general nutrition.

8. The oil acts as a narcotic in cases of pylorospasm, producing, however, no unfavorable effects—neither eructation nor diarrhea.

9. In that form of gastric neurosis, manifested by pain when the stomach is empty, very favorable symptomatic relief has been obtained from the use of olive oil.

10. A certain number of cases of stenosis of the pylorus accompanied by a consequent gastrectasia can often be so much relieved by the oil treatment that no operative procedure need be undertaken. A trial should be made of the oil treatment in all cases of stenosis of the pylorus before advising operative procedure.

11. The treatment prevents prophylactically the production of gastrectasia and prevents relapses when utilized in favorable cases.

Rutherford's conclusions are as follows:—Upon the internal administration of olive oil, typical cases of chronic dysentery, practically without exception, show changes in their condition as follows:—

1. Positive evidence of increased quantities of bile in the feces.

2. Decrease in the number of daily bowel movements, and marked improvement in the character of the same.

3. Gradual cessation of signs of fermentation and putrefaction along the intestinal tract, and consequent subsidence of pain and tenderness.

4. General systemic improvement; gain in appetite; repair of digestive faculties; symptoms of improved nervous system; rapid gain in strength and weight.

5. Apparent positive cure after an average time of two months and upward, with few recurrences.

The treatment is started by giving an ounce of olive oil three times a day for three days, when the quantity is doubled. Rutherford advocates a milk diet and egg albumin with this treatment. Later oil is given in doses of 3 ounces three times a day. This treatment may neces-

sarily be kept up for two months. Gradually the patient is restored to a normal diet.

The author would not advise the milk in this diet, but in its place would give cereal gruels, thin legume purées, vegetable purées, soft eggs and fruit juices.

The Value of Salt in Food.—For many hundred years man has added salt to his diet. It was first used as an aliment at the time of transition from the nomadic to the agricultural life. The use of salt seems to have been unknown to the North American Indians at the time of the discovery of America. There are still many tribes of people living remote from civilization that have never tasted salt. But among civilized people salt is used to-day in excessive amounts.

It was repeatedly stated in Chapter II that sodium and chlorine are essential to the body, and it has been proven in recent years by the researches of Morse, Achard and many others that foods in their natural state contain a sufficient amount of salt for the requirements of the body without the addition of commercial sodium chloride. This addition seems to be craved by civilized man, and the more civilized he is, and the more artificial and complex his life, the greater is the quantity of sodium chloride that he desires in his food.

It is an established fact that a certain amount of sodium chloride is necessary. With an insufficient amount of chlorides, the elimination of chlorine decreases constantly in the urine, and finally may stop entirely, while the tissues at the same time retain their chlorides. Chlorine starvation has a marked influence on certain functions and the digestive juices, especially the gastric juice.

Bunge has said the craving for the addition of salt to a vegetarian diet is natural as many of this class of foods, noteworthy among these the potato, are rich in potash. But other investigators make contrary claims. Richet has demonstrated that the foods required per day on a vege-

tarian diet contain naturally half a dram of salt, and that this amount is what is required daily by the body, and that therefore no addition is needed.

One result of an excess of salt is the greater activity of the kidneys, for the greater the quantity of commercial salt ingested, the greater the quantity of water demanded by the body to maintain the normal specific gravity of the blood.

As a natural consequence of the addition of sodium chloride to the diet, the blood pressure is raised, but this is relieved through water-drinking, by sweating and through the kidneys.

The excessive use of salt in the diet has been claimed by some investigators to produce eczema, dyspepsia and Bright's Disease. The elimination of added salt to the diet is of great value in the treatment of dropsy. The following amounts of sodium chloride per pound in certain foods are given by Strauss:—

Uncooked	Grains
Fruits	4.2
Vegetables	7.0
Cereals	.7–7.0
White of Egg	13.3
Yolk of Egg	1.04
Meat	7.0
Milk	12.6

Goiter as Influenced by Iodin.—Dr. E. R. Hayhurst[6] has published an article worthy of serious consideration concerning the question of the significance of iodin in the prevention of goiter. The main facts are outlined as follows:—

The subject has been investigated by Marine, Kimball, Lenhart, Gaylord, Marsh and others. "Sloan, following Marine's suggestion for animals, advocates an iodized salt

[6] *J. A. M. A.*, Jan., 1922.

for the use of human beings, the proportion of the sodium iodid to salt to be 1–5000, and he observes that, in the evaporation of salt brines, the mother liquor which is removed, takes with it the natural content of iodin which is originally 'found in most of the salt brines from which salt is crystallized.' Both Forbes and Beegle, and Bohn report the entire absence of iodin in various forms of market salt examined."

Of the four halogens, iodin is by far the rarest in natural distribution, but it always occurs in sea water (Abel and Halla). (Chlorin, bromin, iodin and fluorin represent the four halogens.)

The chief natural iodin salt is sodium iodid, and it is about five times as soluble as sodium chlorid. This difference in solubility undoubtedly explains why there is plenty of the former in the earth's deposits, and very little of the latter. In the drying up of seas in ages past, sodium chlorid was the first substance deposited, and often the supernatant liquid escaped with its sodium iodid still in solution. In the second place, such sodium iodid as may have been deposited has been very largely dissolved out for ages through the agency of percolating rains and subsoil waters. Finally, pent up sea brines or supernatant salt solutions of both surface and subterranean types have been subjected so long to similar land-water perfusions as to lose practically all of their more soluble constituents. Thus higher surface altitudes are freest from iodin, while mineral springs, which represent drainings from higher altitudes, show it as among the last places of its occurrence.

This is the explanation given for the absence of iodids and other soluble salts in the great natural salt deposits of the Alps and elsewhere throughout the world.

The relative infrequency of goiter along the sea coasts, and its mild type when present, is mentioned in most text books.

All the salt plants of the United States are inland with the exception of those along the California coast where sea water is the source of supply, but in its manufacture, even this is freed from iodin. The finished product aver-

ages 96 per cent sodium chloride, 3 per cent moisture and the balance principally magnesium chloride.

This brings us to but one logical conclusion. If land animals, including man, must have iodin as a necessary content of their food intake, its one, natural, reliable source is sea water which, however, must be handled and provided in a manner to retain the iodin, and this probably in its organic form. This raises the important question,—should not total sea salts be used as the proper and complete condiment for man and land animals? It must be remembered that it contains, not only the two discussed essentials, sodium chlorid and sodium iodid, but also many other physiologically important salts and salines. It is not poisonous. It can be filtered free of foreign matter, even bacteria. Plants and animals, both sea and land forms, show a selective action for such elements as they need for their functions.

While it is true that most of the sea water elements are widely distributed in the balance of nature, and found in our usual foods, the great solubility of the combinations in which they exist in sea water would appear to warrant giving them, in toto, serious consideration in the dietary of man and domestic animals. May not also the absence of some of the rarer elements, bromin for example, from our usual food intake play an important part in the occurrence of various excitomotor conditions.

The author has known the drinking of sea water before breakfast to benefit cases of constipation and neurasthenia.

Uncontaminated sea water has been recommended for bread making in France, both on account of its various salts required for health, and its magnesium chloride which has an affinity for water, and so causes the bread to keep moist longer; but the yeast must be prepared with fresh water.

Canned Foods.—Canned foods should be used only when fresh foods are not obtainable. Generally some kind of fresh fruit and vegetables are in the market throughout

the year. However, necessities of various kinds demand that either home canned or commercially canned foods be used. When this is the case, the fact should be borne in mind that the temperature and time of processing, and also the period of storage have affected the vitamines. The duration of the heating process destroys more vitamines than the degree of temperature. Some commercially canned foods, peas for example, are subjected to a treatment called blanching which is destined to remove any mucous substance and a part of the green coloring matter that a clear liquor may be in the can. This blanching water is thrown away. As a result, 2.3 per cent protein of peas is thrown away, while the mineral content of blanched peas is found to be 46 per cent less than that of fresh peas.

When canned peas, beans, asparagus and sometimes corn are prepared for use, they are many times drained from the liquor in the can, and as a result there is an added loss of soluble protein, carbohydrate, vitamines and mineral salts. The natural conclusion is that canned foods should not be drained, despite the directions that may be given in cook books.

The bacteriological problem also enters into the question of canned foods, especially in connection with the Bacillus botulinus which has proved fatal through its toxin in many cases. This bacillus is found both in canned meats and vegetables, such as string beans, spinach, asparagus and ripe olives.

Boiling destroys the toxin, but not the spores of the Bacillus botulinus unless kept at this temperature for several hours.

Harvey Weiss [7] says the thermal death point of spores varies with the hydrogen ion concentration of the particular food in question, canned fruits requiring shorter pe-

[7] *J. Infect. Dis.*, Oct., 1921.

riods of boiling than vegetables; it also depends upon the concentration of the food, the more fluid products requiring a shorter period of boiling; it is influenced by the presence and concentration of the syrup, the heavier the syrup, the longer the boiling period required.

Paul F. Orr [8] emphasizes the importance of early diagnosis in botulism as in tetanus and diphtheria because of the fact that the benefits of the antitoxin depend upon early administration:—

There are at least two distinct types of botulinus toxin known as A and B. The antitoxin is prepared against each type and is specific. These facts clearly indicate the importance of using both types of antitoxin, provided the specific type for the toxin is not known.

The method of type determination consists in the intraperitoneal injection in each of a number of white mice of about .05 c.c. of the filtrate of the infected food. Some of the mice have been previously injected with type A antitoxin, and some with type B antitoxin. If previously immunized mice are not available, it is good to mix some of the suspected toxin with type A antitoxin, and some with type B antitoxin, and then inject the mixture into the mice intraperitoneally. Mice of 15–20 gm. weight tolerate 1 c.c. of non-irritating fluid in the peritoneal cavity very well. If the food contains the toxin of type A, the mice receiving no antitoxin and those receiving type B antitoxin will die, while those receiving type A antitoxin will survive. On the other hand, if the food contains toxin of type B, only those receiving type B antitoxin will live. In this way both the presence and the type of the toxin may be determined in from 4–6 hours.

R. Graham and H. R. Schwartz [9] have published some interesting researches on this bacillus.

[8] *J. Infect. Dis.*, Sept., 1921.
[9] *J. Bacteriol.*, Jan., 1921; *J. Infect. Dis.*, April, 1921; *J. A. M. A.*, June, 1921.

The fact should be emphasized that these canned foods may contain this bacillus without any visible signs of decomposition, but the cases of botulism are comparatively rare.

The possibility of ptomaine poisons must not be overlooked in canned foods.

The use of any coloring-matter in canned food is an objection, for many of the coal tar dyes used are harmful.

Copper and zinc may be used to color canned peas. Lead from solder may be absorbed by canned foods. Acids of the foods often erode the tin in which they are contained and preservatives such as sulphuric, boric and salicylic acids are sometimes used in these foods.

Purgatives, Cathartics and Laxatives.—The sale of purgatives, cathartics and laxatives probably averages the largest of all the drugs of the present day, and the principal cause for the enormous demand for these preparations is the widely prevailing malady, constipation,—the other reasons for their demand are small in number.

In many cases it is a gain to purge the intestinal tract when reforming the intestinal flora. At other times quick evacuation is demanded for special reasons. But cathartics and laxatives as a regular régime should be highly discouraged, for they lessen putrefaction only for the moment, and the constipated condition is aggravated rather than lessened.

Since, however, there are cases in which a limited number of administrations of a cathartic or laxative are beneficial, the following classifications are enumerated, with a few comments respecting the advisability of each.

Catharsis is an exaggerated activity or stimulation of the normal function of the intestines, and consequently its action produces irritation and inflammation in a greater or less degree. Therefore, the drug which will produce the desired effect with the least degree of irritation and inflammation and injury throughout the body is the one

that should be chosen. A cathartic is a laxative in a large amount. It acts either by increasing the amount of fluid in the intestines or by increasing the activity of peristalsis. The increase of fluid is drawn from the surrounding blood-vessels.

Classification of the Principal Organic Laxatives and Cathartics

1. **Cathartics Derived from Anthracene.**—Senna, Cascara Sagrada, Rhubarb, Aloes, Frangula.—Cascara sagrada and rhubarb are the least irritating. They affect the large intestines principally in about 5 hours, sometimes 8–12 hours. There may be a certain amount of griping, but no severe inflammation, and they are best administered at night. They may be present in the milk of nursing mothers.

2. **Purgative Oils.**—Castor Oil, Croton Oil.—They affect principally the small intestines.

These oils are hydrolyzed in the intestines, with the production of free fatty acids which are irritating. Croton oil is generally far too violent, and causes severe griping; castor oil produces no griping, and is recommended in cases of abdominal pain.

Castor oil produces action in 3–6 hours and croton oil in 1–2 hours. Castor oil is generally given at night. Both may be present in the milk of nursing mothers.

3. **Olive Oil, Cotton-Seed Oil.**—They affect the small intestines.

These are laxatives and also foods. Ten to fifteen c.c. (½ oz.) a day are given in the case of a young infant. One-half to one wine glass is given in the case of an adult, although this may be insufficient. Should the patient be inclined towards obesity, this would be contraindicated. In such a case, liquid petroleum should be advised.

These oils should be contraindicated in hypoacidity and diabetes (Chapter VII).

4. **Resinous Cathartics.**—Jalap, Podophyllum, Colocynth, Gamboge, Scammony.—These are very irritating and include the drastics. They affect principally the small intestines. They are administered at night or between meals.

5. **Phenolphthalein** (Carbolic Acid, Phthalic Anhydride and Sulphuric Acid).—This may be classified as a laxative, and is valuable in mild cases, and affects principally the large intestines in 8-12 hours.

6. **Agar-Agar, Manna, Liquid Petroleum, Mineral Oil or Liquid Paraffin.**—They are used to soften the feces and increase their bulk. They are mild, non-irritating, unabsorbed, indigestible and incapable of decomposition by bacteria. They affect both the small and the large intestines in 8–12 hours, and are given at night or 2 hours after meals. When the desired effect is not obtained, the dose should be increased.

7. **Salines.**—Salts of Tartaric and Citric Acids.—These affect both the small and large intestines, and are very rapid in action. They may produce some griping. They are not absorbed.

Rochelle Salts (sodium, potassium tartrate) and Citrate of Magnesia are well-known examples.

8. **Bran.**

CHEMICAL COMPOSITION OF BRAN

	Per cent.
Water	12.5
Protein	16.4
Fat	3.5
Carbohydrate	43.6 (Varies)
Mineral Matter	6.0
Cellulose	18.0

The carbohydrate content is variable, ranging in different samples from 10–40 per cent and when this percentage is low, naturally those of the other food principles are higher.

Some of the cellulose gives rise to gas and acid, both of which are laxative. Bran absorbs water, thus increasing peristalsis. It is not irritating in cases of constipation without complication, although this is contrary to many statements. It is also an excellent food with its high content of protein, carbohydrate and mineral matter and a certain amount of vitamines A and B [10] (about six level tablespoons served in hot water or with fruit at breakfast). It is especially recommended by the author for "poor" teeth.

If large amounts of fruits and vegetables do not relieve constipation, bran should be the first laxative recommended. If patients cannot be persuaded to eat it plain in hot water or mixed with some food such as prune sauce, then it should be made a part of every-day cookery, adding it to mush, cakes, cookies and breads. It can replace white flour to the extent of 50 per cent.

A very generous portion of bran in hot water once a day, preferably at breakfast, and a pint of water drunk at night should relieve the majority of cases of obstinate constipation.

Classification of Inorganic Cathartics

1. **Salines, or Hydragogue Cathartics.**—Salts of Sulphuric, Phosphoric and Carbonic Acids, "Milk of Magnesia" (mild) and Magnesium Oxid.—These affect both the small and large intestines, and are very rapid in action. They may produce some griping and are not absorbed.

It is well to administer both the organic and inorganic salines before breakfast, allowing 1 hour for them to take action. They cause a marked increase of fluid from the blood into the intestines as a result of osmotic pressure, and also because of special properties peculiar to the salts.

Epsom Salt and Pluto Water (sodium and magnesium sulphate principally) and Glauber's Salt (sodium sul-

[10] A. D. Stammers, *Biochem. J.*, Vol. XV, No. 4, 1921.

phate) are well-known examples. Hunyadi Water is similar to Pluto Water.

2. **Mercurials.**—Calomel (mild mercurous chloride), Blue Mass (more mild than calomel). Calomel acts principally on the duodenum in 2–8 hours.

It is irritating to the mucous membrane of the intestines, and is best administered at night.

Its value is attributed to its powerful action, and to its antiseptic properties.

Calomel should be followed by a dose of one of the salines, that none may remain in the intestines.

Except in special cases, the author considers the salines the best cathartics, as they are not absorbed, their action is thorough, and rapid, and they produce little irritation.

Enemas.—Oil enemas and water enemas are given when the oral administration of cathartics is contraindicated by gastric and intestinal disturbances. They are given also for their soothing action in excessive colonic and rectal irritation. The oil enema is not as effective as the water enema to soften the feces, and is not as well retained.

Water enemas may be of several kinds,—plain water, salt water, soapy water and mixtures of water with magnesium sulphate and glycerin.

Emetics.—Vomiting is often necessary to expel quickly the contents of the stomach. Drugs used for this purpose produce the effect in two different ways: first, by stimulating the wall of the stomach, causing it to contract and expel the contents; secondly, through being absorbed into the blood, causing nerve impulses to be sent to the walls of the stomach to contract them.

Ipecac is probably the most commonly used drug and is obtained from the roots of a plant of South America. The vomiting is due chiefly to cephaeline and emetine, active alkaloids of the drug. It acts principally on the lining of the stomach. A small portion may be absorbed. It is

usually expelled for the most part from the stomach, and therefore is prevented from producing any harmful results through absorption.

Ipecac is also used as a reliable specific for ameba in the intestines, emetine being the destructive principle. In this case it should be given in coated pills to prevent its acting on the stomach walls.

Mustard is frequently used to produce vomiting,—about one tablespoon to a glass of warm water. The dose may be repeated if the desired effect is not obtained.

Salt is often given in a concentrated form.

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